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Safety Education

Avoiding Electrical Accidents

YEAR by year the number of accidents of all kinds to industrial workers due to disregard of elementary safety precautions affords subject for comment. Legislation and inspection have done much towards eliminating inevitable risks, but the only real remedy lies in the exercise of reasonable care by operatives themselves. That avoidance of danger is not an inborn tendency is shown by the greater likelihood of accidents happening to young people, and in the paper which he read before the National "Safety First" Conference at Birmingham last week, Mr. A. P. Young drew a quite legitimate deduction from the pre-eminence given by Herbert Spencer to the art of direct self-preservation as a factor in education. This implies, as Mr. Young says, that this ability can be developed only through education, as a result of which the worker will develop an "inner safety consciousness."

An Example of Co-operation

The problem is essentially one for co-operation between management and workmen, and the active share taken by the operatives in running the safety organisation is one of the best points of the B.T.H. scheme described by Mr. Young. Another good feature is the recognition shown, by the recreational facilities provided, of the value of quick mental reaction combined with good muscular co-ordination.

So much for methods by which "out of this nettle, danger, we pluck this flower, safety" with regard to industry generally. A question that concerns us even more closely is how far the increasing use of electricity has added to the total number of accidents. A short answer would be that in rounding off the figure of 192,539, the aggregate number of industrial accidents last year, those of electrical origin would be practically eliminated, since there were only 583.

That puts matters in their right perspective, but the real point for electrical engineers is how far can accidents due to design and construction or to maintenance of electrical apparatus be prevented. In another paper at the same conference, Mr. F. H. Mann, taking the objective viewpoint of a a Government official, stated that accidents due to the former cause have diminished in recent years in comparison with those attributable to the human factor. His most important points, having regard to the occasion of their utterance, related to portable appliances. These are used largely by men who are unskilled electrically and who, with young persons, are responsible for a proportion of accidents which tends to rise with the progress of general industrial activity; there is no parallel increase in the number of injuries to skilled electrical mechanics. His recommendation that all portable apparatus should be called in periodically for thorough examination should especially be noted.

While shock is responsible for only about one-third of all electrical accidents, it is the cause of most of the fatalities of electrical origin. How many of the latter need have occurred if prompt treatment had been given to the sufferer? Medical opinion is that death from electric shock is only apparent at first and that, however severe the accident, there is always a short period during which the victim can be revived, if resuscitation treatment is started immediately. Our own long interest in the subject is symbolised by the ELECTRICAL REVIEW instruction sheet which was produced in its first form more than forty years ago. A Home Office regulation requires instructions of this kind to be affixed in all premises where electrical energy is generated, transformed or used above 250 V DC or 125 V AC, but in order that its intention may be fulfilled, all men who may in any way be concerned should undergo the simple training required.

Resuscitation

In addition to the general safety arrangements discussed by Mr. Young, the organisation described allows for the instruction of all testers, wiremen, and switchboard attendants in methods of inducing artificial respiration. These trained men can be brought to the scene of an accident immediately by a signalling system. Unfortunately, the elaborate methods possible at a large works cannot be adopted everywhere. Take the case of an electrical fitter and mate sent to carry out repairs at an unattended substation. If the fitter receives a shock, is his labourer trained to cope with the situation? Yet the simple procedure necessary can be quickly mastered by anyone.

No doubt the fact that very few instances of severe shock are encountered by the average electrician—many have worked all their lives on electrical apparatus without first-hand experience of a serious case—may lead to lack of interest in first-aid. Nevertheless, it might happen to anyone to find himself in a position where a little easily acquired knowledge would have made all the difference.

Crompton's and Callender's

SINCE the announcement in July that Crompton Parkinson, Ltd., and Callender's Cable & Construction Co., Ltd., were negotiating a close working arrangement the shareholders and staffs of the two concerns, as well as the rest of the electrical industry, have been anxiously awaiting the result. It has now been decided not to proceed further in the matter owing, it is said, to the recent crisis and the unsettled conditions of world trade and finance. The original proposal involved the formation of a holding company to take over the whole of the capital of the two companies amounting to about £3,000,000.

Lighting Education

IN its earlier stages the Lighting Service Bureau of the Electric Lamp Manufacturers' Association was of the nature of a museum—or perhaps it would be better to say a permanent exhibition—of lamp and lighting developments. As such it was merely passively educational. In recent years a more active policy has been pursued. In conjunction with E.D.A. effective campaigns have been conducted to impress upon the general public, factory owners, hotel proprietors, shopkeepers, etc., that better lighting means better sight, better production and better business. Another sphere of activity has been the education of the electrical industry itself by means of Illumination Design Courses. To these have come thousands of electrical contractors and members of electricity supply authorities' staffs so that to-day there exists a very active force working for the literal enlightenment of the nation. So popular have the courses become that the accommodation in London is now overtaxed and courses are being organised in a number of provincial centres. If there are still readers interested in the lighting art who have not yet visited the Bureau or attended a design course we recommend them to do so at the earliest opportunity.

Visible Results

THE effects of the Bureau's work are everywhere apparent. To this more than anything else can be credited the vast amount of floodlighting now employed and the generally better aspect of the shopping centres of towns all over the country. A particularly prominent development has been the introduction of the discharge lamp. The progress made since the system was introduced three years or so ago has been phenomenal and hundreds of miles of streets are now illuminated by this effective agent. The Bureau's efforts are now being directed towards the factory in which matter it will have the "backing" of the Home Office under the new Factory Act—to what extent will not be known until the Departmental Committee dealing with the subject has reported.

Transport "C" Stock

THE announcement of a final distribution of 2½ per cent. on its "C" stock (making 4 per cent. for the year) by the London Passenger Transport Board places the Board within the shadow of a receivership. The terms of issue provided that the interest on the "C" stock should be 5½ per cent. and that if this dividend were not paid for three consecutive years, commencing with 1935-36, 5 per cent. of the holders of the stock could apply for the appointment of a receiver. For the third time the interest has been below the standard and the holders of the stock are in a quandary. Whether a receiver could manage the system better than the present controllers is open to question. The chairman of Thomas Tilling, Ltd., which company itself holds more than the requisite 5 per cent. of the stock, suggests that the position could be straightened out by an average increase of 2½ per cent. in fares. The present situation is attributed largely to the conservative policy adopted in respect of appreprations for renewals and maintenance which, of course, safeguards the future if it means immediate disappointment for the "C" stockholders.

Coal and Trolley Buses

ADVERSITY makes strange bedfellows. Although we have always maintained that electricity is not an enemy of the coal industry the latter has been doubtful about it. But the threat to substitute oil buses for trams in a number of towns has lined the coal industry up with suppliers of electricity. We have already referred to the active opposition put up by the Coal Utilisation Council to the Manchester proposals and in the Council's September *Bulletin* this matter is reported, together with details of steps taken at Hastings, which resulted in the Town Council deciding to retain the trolley buses instead of permitting their abandonment in favour of oil buses.

Testing after Overhaul

REPORTING on the fatal accident that occurred on the District Railway earlier in the year due to a faulty reconnection of a signal circuit, Lt.-Col. E. Woodhouse drew attention to the need for testing apparatus after any alteration, however trifling, had been made. A further illustration of the result of failure to take this elementary precaution is furnished by the Board of Trade report regarding the violent explosion of a multi-tubular auxiliary boiler operated at 200 lb. per sq. in. in the s.s. "Kingswood." The boiler, which was 10 ft. 6 in. long and 12 ft. in external diameter, was projected 164 ft. along the vessel through two holes, before it ruptured the shell plates at the bows a few inches above the water line, and so damaged the main boilers and engine as to render them unfit for service. The Engineer Surveyor-in-Chief, Mr. W. T. Williams, states that in no case has shortage of water alone on a marine boiler caused more than localised disturbance. He refers to the significant fact that the safety valves had been overhauled shortly before the explosion but had not been tested under steam, nor had the easing gear been replaced. He emphasised again the necessity to make a trial of any appliance, no matter how unimportant it may appear, after it has been overhauled.

The Television Load

ELECTRICITY supply authorities have every reason for satisfaction in the promise of television for all in due course. A list of the receivers available given in the *Wireless & Electrical Trader* shows that their power requirements range from 110 W to as much as 270 W, most of them needing 200 W or more. When programmes are as continuous as the present sound broadcasting four or five hours' use a day will be quite usual. There are over eight million listeners who are potential "viewers" and so we can reckon upon a consumption running into many millions of kWh a year in a future which is, perhaps, not so remote as pessimists would have us believe.

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Electricity for Collieries. By J. F. Smith, B.Sc.

The case for public supply

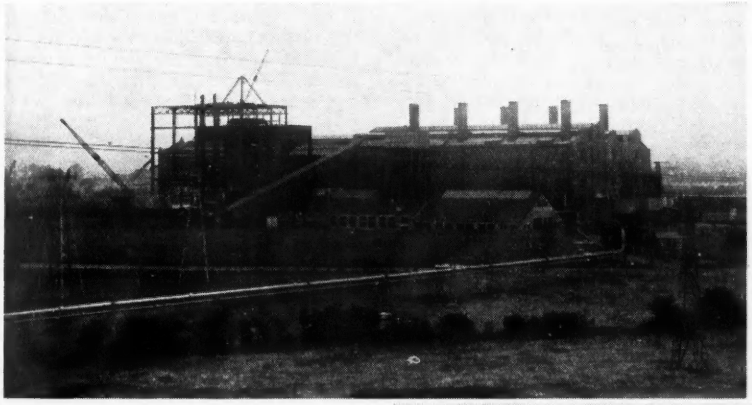
The author has endeavoured to present his case in as general a manner as possible, but even so he is aware that his remarks may be strongly influenced by South Wales conditions, and that in other coalfields, particularly in Scotland, very different load conditions may obtain.

A CAREFUL record and study of the power requirements of collieries throughout one of the most extensive coalfields in this country has quite convinced me of the not unexpected fact that no two collieries are alike in their requirements of power and the use to which such power is put. Power requirements at collieries are essentially subsidiary to mining requirements and may be allocated to two uses: first, to maintain the colliery in a condition fit and safe for the winning of coal and, secondly, to drive all those machines concerned with the flow of coal from the coal face to the colliery siding.

The first requirement, at least in the South Wales coalfield, is generally the more important and usually represents a substantial quantity of electricity taken at high load factor and power factor for the purpose of driving ventilating fans, pumps and air compressors in so far as these are used to drive compressed-air pumps inbye.

The second portion is that required for cutters and conveyors where these are electrically driven, or for driving the air compressors when they are not, haulages, winders, creepers and screens, all concerned with the flow of coal, together with general surface and workshop drives. This section of load is generally the smaller and of lower load factor and power factor, occurring as it does in the working shift only.

Physical conditions as between collieries vary enormously, as do the quantities of coal produced, and it follows that the electricity consumption and the character of load vary accordingly. The supply of electricity in this country has been entrusted to a considerable number of undertakings, each with costs and conditions peculiar to itself, with the inevitable result that charges for services vary from area to area. A comparison of private and public supply costs at any particular colliery can therefore have no application whatsoever to the general case for or against public supply at collieries, and the above brief examination will demonstrate how fallacious a general expression of opinion must be when based on such a limited comparison.



The Upper Boat generating station of the South Wales Power Co., showing extensions in progress for boiler and generating plant and grid sub-station on right

Basis for Comparison

It is suggested that a comparison between private and public supply of electricity should take into account, first, the quality of the supply and, secondly, the costs of supply. The word "quality" is used in a comprehensive sense, including maintenance with narrow limits of voltage and frequency, reliability, availability of standby capacity, availability of spare capacity for growth of load or emergency, together with engineering service made available to the mining engineer. The aim of mining engineers is to place coal on the colliery sidings at the lowest possible production costs. These costs include mining costs per ton of coal produced which usually far outweigh the costs for power, and while it is not suggested that power costs are unimportant, mining engineers agree that quality of supply, particularly in respect of reliability, is more important than some slight difference in the cost per kWh. In fact, any feature of the electric power supplied to the pits which either interrupts or restricts the flow of coal is one which, while difficult to value in monetary figures, must weigh heavily against the value of the supply adopted.

Mr. J. F. Smith, B.Sc., A.M.I.E.E., is power consumers' engineer to the South Wales Power Co.

While it is customary to value electricity in terms of the cost per kWh electricity supply is essentially a service and to obtain a true comparison the relative values of the service given must be compared rather than merely the relative costs of energy as registered by the meters.

Colliery power plants vary enormously in size, age, efficiency and the loads with which they have to deal, and it must be admitted that on the first two aspects of quality of supply, *i.e.*, voltage and frequency, the supply afforded by a public supply authority, working as it does within the narrow limits prescribed by the Electricity Supply Regulations, is in general superior to existing private plant.

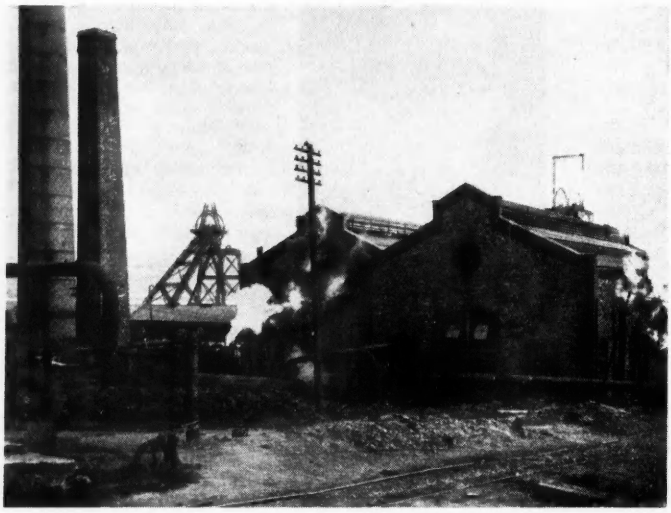
It is the practice of the power company in the area with whose system I am familiar to operate transmission lines in a series of ring mains looping in and out of colliery and works sub-stations, these ring mains being again interconnected at system transforming stations with higher voltage ring mains fed from a central power station, with the result that incoming lines to colliery sub-stations are usually in duplicate and frequently in triplicate.

Value of Spare Capacity

Power supply authorities usually erect lines with a view to future load development and, except in rare cases, there is always spare capacity in their lines to meet sudden development of load or emergency. Colliery companies have often avoided a serious situation due to a sudden inrush of water or other emergency by availing themselves of such spare capacity. In power stations operated by supply authorities there is always a proper proportion of spare generating plant capacity, frequently backed by the large resources of the grid, and continuity of supply and availability of extra supply from the power station bus bars are thereby assured.

There is further the benefit of service made available by

most public supply authorities, by which expression is meant those instances of assistance asked and readily given. The loan of a meter, a motor or transformer to replace one which has failed, the offer of additional capacity to meet some temporary power emergency and the like are examples of what is covered by the term "service." It is appreciated that there are colliery companies owning modern and efficient generating plant who can claim to give a high quality of supply to their pits, but the case presented in this article is necessarily on general lines and visualises conditions as they exist to-day, and there can be no doubt that the quality of supply given from public electricity mains is, in most cases, far superior to that afforded by private generation plant.



A typical colliery generating station in South Wales

If a true finding is to be obtained it is essential that costs of private and public supply should be compared as for equal service, and it must be remembered that the cost at which public supply can make electricity available to a consumer is made up of capital charges and running costs. Any charge for power supply to a consumer must necessarily be a reflection back to that consumer of the load which he presents to the supply authority, and in this regard the magnitude of consumption, the time at which the maximum demand occurs, the load factor, the power factor and the steadiness of load will all have their appropriate effect.

When Private Plant is Inadequate

If, therefore, the supply authority is asked to quote for that load by which the colliery's needs have over-shot the capacity of the colliery generating plant, with the suggestion that the colliery plant should deal with the steady base load and that the supply authority should take the excess, it is obviously impossible for a supply authority to quote attractive rates, particularly in an area where the colliery day shift load cannot be considered as off peak in view of a preponderance of industrial consumers of electricity. Again, it is unreasonable to compare the cost of energy obtained from a supply authority with that produced by private plant which lacks stand-by or spare capacity, where those necessary features are available in the purchased supply.

The argument is often put forward for an existing private plant that its capital cost was quickly written off in the first few years of its life and that it therefore now carries no capital charges, so that a comparison is drawn between the running cost of such plant and the comprehensive cost of purchased supply. It is hardly necessary to point out that, taken over the life of the plant, the private generation costs are but little affected by the fact that large amounts of the capital costs were written off in the early years; in fact, to a certain extent the private plant owner has paid in advance for his electricity.

Factors Affecting Charges

At a casual glance it might appear that a colliery company should be in a position to generate electricity at or below the costs incurred by a public supply authority in generating and delivering such energy to a colliery from a power station which may be more or less remote. The following examination of the make-up of a supplying authority's costs and private generation costs will demonstrate that this is not so.

The size of a private generating station must depend on the existing and anticipated electrical loads, and the supply authority has a great advantage in dealing at one central point with the combined loads of a large number of industrial concerns. It is thus possible for the authority to operate a large station with those adjuncts necessary to attain the highest efficiency which are relatively costly in a small station but not so costly per kWh sold from a large one. Such central stations do, moreover, take coal in large steady quantities and can therefore buy at economical rates, with the advantage that a range of varieties of coal best suited to combustion conditions is always available, the final choice being made with a view to obtaining the lowest cost per heat unit developed in the boiler plant. Provision for ample cooling water is invariably made and these factors, combined with the large steady output maintained, produce fuel costs per kWh much lower than can be achieved by private generation plants. Other running costs such as wages, maintenance, oil and stores are all spread over a greater output, the resulting cost per kWh being corresponding low.

Capital charges form an important proportion of the costs of producing electricity, and it is possible to buy generating and boiler plant in large units more cheaply per kW capacity than in the smaller sizes, and such charges again spread over a large steady output represent relatively low capital charges per kWh sold from the station. Some of these advantages are partially offset by costs of transmission, but it must be remembered that public supply transmission systems deal with a variety of industrial loads, the times of incidence of such loads often being different. The effect of this diversity is that the transmission cost per kWh delivered is much lower than that which might be expected at first sight, or obtained over a private transmission system. There is every reason to expect, therefore, that the charges of a supply authority for electricity delivered at a colliery must compare favourably with the costs of private generation. The proof of this is that the sale of electricity to collieries is rapidly increasing, while there is a corresponding decrease in the amount of private plant continuing in service.

Private Generation Costs

The component costs of producing electricity at a private colliery generating plant will include fuel, stores, oil and water and wages plus capital charges on the generating plant. At one time it might correctly be said that the colliery generating plant was in the more advantageous position as regards fuel cost, but with the development and general adoption of combustion plant to utilise the smaller sizes and lower grades of fuel, such fuels now find a ready market and have an appropriate high commercial value. There is, therefore, little to choose between the cost per ton which should properly be allocated to the colliery boiler fuel and the terms upon which a central station can place its large and steady order for fuel. Undoubtedly there is available at some collieries quantities of coke breeze, washery slurry and dust, which are not in sufficient or constant quantities to be worth marketing, and can be disposed of in the colliery boiler plant. Rarely, however, do such fuels form more than a small portion of the boiler coal, the balance invariably being made up of good saleable material.

Cooling water often presents a difficulty in private plants which cannot generally be located on sites adequately served with natural water facilities, and thus in thermal efficiency and fuel cost per kWh generated the supply authority's station is most often at a distinct advantage. Although the cost of stores, oil and water is only a small portion of the resulting cost per kWh, the item is in favour of the supplying authority's station where such costs are spread over a much greater output.

Capital charge determination presents no difficulty, but the charges must in equity to public supply be based upon charges carried by a plant which will give equal service and has both margin for development and adequately standby capacity, this applying to boiler plant, steam drives and auxiliaries as well as to the generators themselves. In many collieries the stand-by plant would require to be a second machine equal in size to the first, both capable of meeting load development. Here the supply authority is at a great advantage in that such a high proportion of stand-by plant is unnecessary and one set equal to the largest of the running sets is sufficient, the one machine acting as stand-by to several. The proportion of idle plant is, therefore, much lower and the capital charges per kWh sold are greatly in favour of the public supply authority's station.

The conclusion is therefore put forward that for equal service of electricity a public supply authority can usually deliver energy more cheaply to a colliery switchboard than it can be produced by generating plant at the colliery.

Discharge-lamp Circuits

By G. W. Carter, M.A. (B.T.H. Research Laboratory)

Measuring electrical characteristics and estimating their variations

ALTHOUGH measurements made on discharge-lamp circuits are carried out by well-known methods, the special nature of the lamp exposes the experimenter to certain pitfalls which are not universally realised, and the quantities so measured are affected considerably by variations in circuit conditions.

The high-pressure mercury-vapour discharge lamp is typical in many ways of the lamps under review. It is connected across the AC mains in series with an iron-cored reactance, and becomes ignited and extinguished once during every half-cycle of the supply voltage. The overall power factor of the circuit is usually about 0.55, so when the arc is extinguished at current zero the mains voltage has attained 80 per cent. of its peak value. This suffices to re-establish the arc

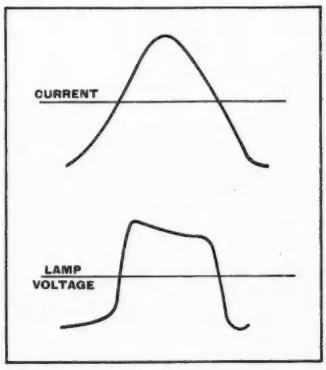


Fig. 1.—Operation of a mercury lamp with choke

almost instantaneously in the opposite direction; whereupon the arc voltage drop falls slightly from its ignition value, and then remains almost constant until just before the next extinction. The lamp voltage wave is therefore flat-topped; the voltage applied to the choke is peaky. The arc exercises very little control over the shape of the current wave, which is therefore determined by the application of this peaky voltage to the iron-cored choke; the resulting current wave is less peaky than the voltage, but still contains a third harmonic of 5 to 10 per cent. (fig. 1).

The lamp has an effective power factor of about 0.9, not, of course, because inductance or capacitance is present, but owing to the difference in shape between the current and voltage waves. The characteristics of such a circuit will be affected, to an extent not easily predetermined, by the connection of resistive meters in parallel with either lamp or choke. The effect is minimised by the use of meters of especially high resistance, but with certain precautions meters of normal type are satisfactory and their use is assumed in this article.

Mercury Lamp Measurements

(a) *The Lamp*

The lamp voltage is controlled by the quantity of inserted mercury. If a measurement is desired, the connection, in parallel with the arc, of a voltmeter of 20 ohms per volt, makes little difference to the arc voltage drop, but when the lamp wattage is being measured the power consumed by a wattmeter potential coil connected in the same way requires consideration. Allowance must be made for wattmeter loss, in measuring the power consumed by a resistive load; does the same apply to a lamp load?

The answer is supplied by the process of lamp operation. The lamp voltage wave is affected very little by moderate changes in circuit voltage or current; consequently the voltage across the choke is also nearly unaffected, and with it the total current taken by the lamp and its parallel meters. The power taken by these is therefore nearly the same as it would be by the lamp alone; that is, no correction should be applied to the wattmeter reading, for the potential-coil current is, as it were, extracted from the lamp current.

(b) *The Choke*

The choke voltage is seldom required to be known, but the choke loss frequently is. This may be done by simultaneously measuring the line and lamp wattage, and subtracting the latter from the former, but the method is not satisfactory, for it attempts to measure a quantity by taking the difference of two quantities perhaps twenty times as great. If the uncertainty in either reading is ±0.5 per cent., the uncertainty in their difference is therefore ±20 per cent.

A far preferable method is to use a low-power-factor wattmeter to measure the choke watts directly. This involves connecting a potential coil across the choke, so that a small quadrature current is passed into the lamp (fig. 2). This advances the time of arc extinction, bringing the lamp voltage a little more into phase with the supply voltage and reducing the voltage applied to the choke. A slight reduction in choke loss ensues, partially compensating for the potential coil loss, so that the customary correction is too high.

It is therefore necessary to observe the change in wattage reading when other known resistances are connected in parallel with the choke. This change is a linear function of the conductance across the choke; the line may legitimately be extrapolated to conductance zero, to give the true choke loss. Two readings suffice to give this line, one with wattmeter only and one with an additional parallel resistance equal to the wattmeter resistance; the difference of the readings gives the required correction.

In any case, all circuits in parallel with the choke should be opened before measurements are made on the lamp, and *vice versa*. Accurate adjustment of supply voltage and frequency is essential, for a 1 per cent. change in voltage leads to a 2.3 per cent. change in lamp wattage and to a 4.6 per cent. change in choke loss; while a 1 per cent. change in frequency will change the lamp wattage by 1 per cent., though it does not seriously affect the choke loss.

Owing to the effect of wave-form, measurements of choke loss taken with a lamp differ considerably from those taken with sine wave current. To measure the latter is therefore very misleading.

Sodium Lamp Measurements

While the operating process of a sodium lamp in its steady state strongly resembles that of a mercury lamp, in practice there is an important difference. The striking of the initiating arc (in neon or other inert gas) requires a voltage of the order of 450, so that on normal supply voltages a step-up transformer is necessary in addition to the choke. These are usually combined in a high-reactance transformer.

The argument in favour of non-correction of the reading of a wattmeter in parallel applies also to a sodium lamp—though less accurately, for the lamp voltage falls with rising current faster than with mercury. Nevertheless the lamp voltage may still be regarded as independent of current if the

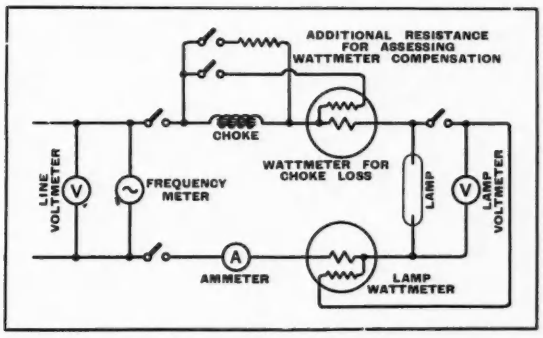


Fig. 2.—Testing circuit for mercury lamps and chokes

wattmeter current is less than 2 per cent. of the lamp current; the wattmeter reading then gives the true lamp wattage without correction.

The measurement of transformer loss is less easy, unless a two-element wattmeter is available. The method of two separate wattmeters is not quite so inaccurate for measuring transformer loss as for choke loss, as the loss is a larger proportion (perhaps ⅓) of the transmitted power; thus, if the accuracy of either reading is ± 0.5 per cent., that of the measured loss is ± 6 per cent. A more accurate method, though tedious, is a calorimetric one; the transformer is immersed in oil and a time-temperature curve taken when in operation with a lamp; the transformer is then short-circuited and supplied with known watts, which are varied until the same curve is obtained. The loss in these transformers with the secondary short-circuited is nearly always within 10 per cent. of the loss with a lamp load. This short-circuit loss is easily measured with a single wattmeter.

The operating wattage of a discharge lamp, and the choke or transformer losses, are affected by variations in the circuit elements and in the applied voltage. An estimate may now

be made of the spread which the measured readings may show. In discussing the errors to which mercury-lamp circuits are prone, as the permitted tolerances have not yet been in every case standardised, the quoted variations are to be regarded as typical only.

Wattage Error in Mercury Lamps

(1) The lamp voltage drop assigned to a given supply voltage may lie anywhere within a certain range decided upon by the designers. The corresponding variation in lamp wattage depends upon certain variable factors, especially the degree to which the choke is saturated at the operating point; an average figure might be ± 1.5 per cent.

(2) The overall impedance of the choke is subject to a manufacturing tolerance, which may be taken as ± 2 per cent.; this will lead to a wattage error of the same value.

(3 A number of supply voltages is commonly catered for by combinations of a smaller number of choke taps, so an element of compromise enters into the location of those taps, and manufacturing tolerances must be made upon their spacing. For these reasons, even if the impedance of the choke is correctly set on a certain tap, it will not be quite right on other taps; this will probably allow a wattage error, due to tap location, of ± 2 per cent.

(4) The mean value of the voltage at a point may differ from the nominal lamp-and-choke voltage; for instance, if the choke is tapped for 5-V steps in supply voltage, a 230-V lamp and choke must serve on one tap for all local voltages from 227.5 to 232.5. Experimentally, a variation of 1 per cent. in applied voltage changes the lamp wattage by about 2.3 per cent.; so the above error of 1.1 per cent. in voltage will lead to a wattage error of ± 2.5 per cent.

In laboratory testing, the applied voltage will be appropriate to the lamp and to the choke tapping, and only the first three sources of variation will be found; adding them, we see that a lamp operated with its choke under correct voltage and frequency conditions suffers from a wattage uncertainty of 5.5 per cent. This statement, however, gives too harsh a picture, for it is unlikely that all three sources of error will reinforce each other.

If testing is carried out "in the field," or where voltage control is not available, the fourth cause of variation will bring the total wattage uncertainty to 8 per cent., and during the operating period of the lamp, time-to-time voltage fluctuations may lead to wattage variations over a wider range still.

Loss Variations in Mercury-lamp Chokes

(1) The variation in lamp voltage drop affects the choke loss markedly, for a lamp of voltage drop higher than the average reduces the voltage across the choke and the current through it, thereby diminishing both iron and copper loss. A satisfactory and reasonable variation in lamp voltage is about ± 5 per cent. and the corresponding variation in choke loss is ± 10 per cent.

(2) A variation of ± 2 per cent. in the overall choke impedance will cause in the choke loss a variation of ± 2 per cent.

(3) A variation of ±2 per cent. in the location of the choke

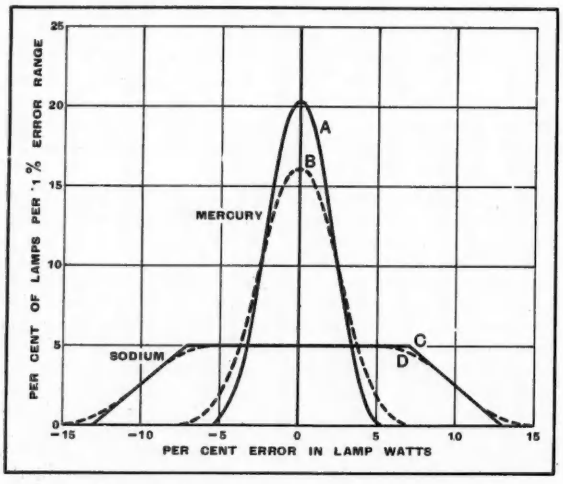


Fig. 3.—Distribution curves for discharge lamp wattage

tappings will also cause in the choke loss a variation of ±2 per cent.

(4) A deviation of ±1.1 per cent. between the supply voltage and the nominal lamp-and-choke voltage will affect the choke loss by ± 5 per cent.; for both choke voltage and choke current vary by ± 2.5 per cent., and the iron and copper losses vary nearly as the square of the voltage and current respectively.

In testing with controlled voltage, therefore, the choke loss is uncertain by ± 14 per cent.; with uncontrolled voltage, supposing that the choke tapping nearest to the local voltage has been selected, the uncertainty is ± 19 per cent. This, of course, only introduces an uncertainty of between 1 per cent. and 2½ per cent. in the power consumed by the installation—in addition to the 8 per cent. by which the lamp wattage may vary. If, however, any guarantee of losses on the choke itself is considered these uncertainties are much more important.

Wattage Error in Sodium Lamps

The sources of wattage error in sodium lamps are the same as with mercury, but the magnitudes of the errors are different.

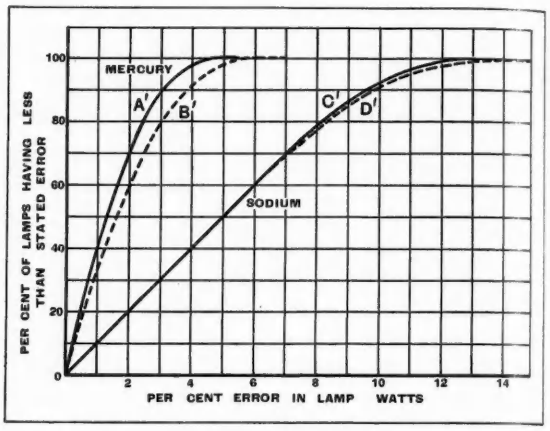


Fig. 4.—Integrated distribution curves for discharge lamp wattage

(1) The current supplied by the transformer to the lamp is nearly independent of lamp voltage, so the percentage spread in lamp wattage is about the same as in lamp voltage; a satisfactory and reasonable figure is approximately ± 10 per cent.

(2) The primary taps of the transformer are in simple turns ratio, no compromise being required; consequently their location is somewhat more accurate than in a mercury-lamp choke. A tolerance of ± 3 per cent. will probably reasonably cover all transformer variations.

(3) The sodium lamp is less sensitive than the mercury lamp to discrepancies between the marked and operating voltages; a variation of 1 per cent. in voltage changes the lamp watts by about 1 per cent. This is counterbalanced, however, by the provision of transformer tappings for 10-V steps of supply voltage instead of 5-V steps as is common with mercury-lamp chokes. The variation in lamp wattage due to the finite tapping steps is ± 2 per cent.

In testing with controlled voltage, therefore, the wattages of a sodium lamp may diverge from the average value by ±13 per cent.; with uncontrolled voltage the divergence amounts to ± 15 per cent.

The loss in a sodium-lamp transformer is not susceptible to very large changes. Variations in lamp voltage scarcely affect it; variations in the transformer itself may cause a spread of ±3 per cent.; variations in supply voltage from the marked value will give ±4.5 per cent. In testing with controlled voltage, therefore, the transformer loss is uncertain by ± 3 per cent.; with uncontrolled voltage by ± 7.5 per cent.

Distribution of Lamp-wattage Errors

If the deviation of a quantity from its intended value is controlled by the separate operation of a large number of small causes, the errors are distributed in a so-called normal frequency distribution. In some cases, however, the deviation is not due to the separate operation of a large number of small causes.

A characteristic may be adjusted to be within certain limits, or articles having a characteristic within the required limits are selected from a larger number. In both these instances, the simplest assumption is that the characteristic is equally likely to have any value within the range. Examples of such a uniform distribution are these:—

(1) The impedance of a choke, adjusted to lie within a certain range.

(2) The voltage drop of a discharge lamp, when lamps

having drops within required limits are selected from a much wider voltage band.

Whatever the type of distribution, it is specified by a "distribution function" $f(w)$, such that the proportion of articles having a deviation between w and $w+\delta w$ from the mean value is:—$f(w)\,\delta w$ ..... (1)

Let there be two sources of error, 1 and 2, both operating upon a wattage of lamps. If the error 2 is eliminated, suppose that a fraction $f_1(w)\delta w$ of the lamps has wattage errors between w and $w+\delta w$; if the error 1 is eliminated, suppose that this fraction is $f_2(w)\delta w$.

Then, if both sources of error operate simultaneously, the fraction of lamps having wattage errors between w and $w+\delta w$ is:—$\delta w \int_{-\infty}^{+\infty} f_1(w-x)\, f_2(x)dx$ ..... (2)

In particular, suppose $f_1(w)=k$ when $-d<w<d$, but $=0$ when w is outside those limits; this is the analytical description of a uniform distribution between fixed limits $\pm d$. Since every lamp must lie somewhere within the error range $-\infty$ to $+\infty$, $\int_{-\infty}^{+\infty} f_1(w)dw=1$. This gives $2kd=1$, or $k=1/2d$.

Substituting this value for $f_1(w-x)$ in the integral (2), we get a fraction $\delta w \int_{w-d}^{w+d} \frac{1}{2d} f_2(x)dx$ ..... (3)

Therefore, to superpose upon an error distribution $f(w)$ the effort of an error distribution constant between limits $\pm d$, the mean value of $f(w)$ must be plotted at every point w over the range $w-d$ to $w+d$. The resulting curve is the combined error distribution curve.

We now derive the combined error curve for mercury lamp wattage, as controlled by variations in the lamp and choke. In fig. 3, curve A shows the result of combining three uniform distributions, namely: Lamp error, uniform within ± 1.5 per cent.; overall choke error, uniform within ± 2 per cent.; choke error between taps, uniform within ± 2 per cent. Curve A^1 in fig. 4 shows the proportion of cases wherein the error lies within given limits.

Curve B (fig. 3) has been derived by combining with curve A the error due to deviation between supply voltage and choke tapping, and curve B^1 in fig. 4 again shows the proportion having errors within given limits. The two curves A, A^1 therefore illustrate the distribution which would be obtained if a large number of lamps were tested under laboratory conditions, while curves B, B^1 illustrate the distribution if they were tested under service conditions. Similar distribution curves could be drawn for choke loss; but this is less important.

Curve C (fig. 3) shows the result of combining two uniform distributions in the case of sodium lamps, namely: Lamp error, uniform within ± 10 per cent.; transformer error, uniform within ± 3 per cent. Curve D is derived from curve C by including also the error due to deviation between supply voltage and transformer tapping. Curves C^1, D^1 are equivalent to C, D, but show the proportion of cases wherein the error lies within given limits. Distributions C, C^1 would be obtained by laboratory testing, D and D^1 by testing in the field.

Time-to-time Voltage Fluctuations

It has been assumed that, when testing is carried out in the field, the supply voltage is measured and the choke or transformer connected on the nearest tap. Voltage, however, is permitted to vary from its declared value by ± 6 per cent.

Suppose, then, that a 230-V mercury lamp and choke are connected across a 230-V supply. It has been already shown that, at declared supply voltage, the lamp wattage will be within 5.5 per cent. of its correct value. As the supply voltage, however, may vary by 6 per cent. (from 216 to 244 V) the corresponding fluctuation in lamp wattage is ± 14 per cent., allowing for differences in mean value of the supply voltage from the lamp-and-choke voltage. For sodium lamps, the lamp wattage with correct supply voltage is now uncertain by ± 13 per cent., while the time to time fluctuation is ± 6 per cent.

Considering, therefore, the wattages of all the lamps in an installation, at all times of their use, the following conclusion may be drawn. The total variation found among either mercury or sodium lamps is practically the same—namely, ± 19 per cent. Mercury lamps, however, vary little among themselves, yet fluctuate considerably with voltage, whereas sodium lamps, varying more widely among themselves, are more nearly constant with time-to-time fluctuations of voltage.

No new principle is involved if the argument is extended to the luminous output of the lamp, or even to the light intensity on a road surface. The concept of spread would seem, in fact, to be of considerable importance over the whole field of lighting practice. In conclusion, I wish to acknowledge the contributions to the technique of lamp measurement made by my colleague, Mr. H. R. Ruff.

Electrical Safety in Industry

The importance of correct layout of equipment and adequate training of young employés

TWO papers of an electrical complexion were presented at the Regional Industrial Safety Conference held at Birmingham on October 5th under the chairmanship of Dr. A. H. Railing. The first, by Mr. F. H. Mann (Electrical Inspector of Factories), on "Electrical Hazards," dealt with layout and maintenance questions. Starting with high-voltage switchgear, he referred to the need to sectionalise switchgear when supplies were of sufficient magnitude, each group in its own compartment equipped with permanent automatic fire extinguishers, which should also be provided, together with pebble-filled pits, in transformer chambers. Transformers were preferably installed out of doors. All substations should be of fire-resisting construction with alternative means of egress. Scarcely less important than the correct choice of high-voltage switchgear was the need to relate the rupturing capacity of factory distributor switchgear to transformer capacity as extensions were made. Where this would reduce flexibility reactors could be used. High-rupturing capacity fuses could be used as back-up protection for inadequate switchgear in some cases.

Local isolation should be provided for all motor starters. When push-button control of dangerous machinery was employed, isolation should be by a switch and not by links. A push-button in series with the no-volt coil of the motor starter provided the simplest method of wiring. For crane isolating switches, the Factory Department asked for a locking device. Trolley wires at a low level should be enclosed or 50 or 100 V should be used. Lifting magnet circuits must not be interrupted except on the magnet controller, and reliance should be placed on the main protection for the crane and not on local fuses in the cabin. Sectionalisation of the trolley wires in long bays had been found advantageous.

If reliably low earth resistances were unobtainable, the usual protection, depending on an excess current of from 50 to 75 per cent. above the normal, might not be secured, but an earth-leakage device would reduce the tripping current required to only one-third of full-load value.

All portable apparatus should be called in at short intervals for examination and insulation and earth continuity tests. Only plugs incorporating an earth contact and of the side-entry type should be used with interior grooves to prevent the earth wire coming into contact with the phase terminal. Portable lamps and tools should be designed for 100 V or less; in boilers and tanks 25 or 12 V was required for safety. Miniature earth-leakage circuit breakers were recommended where good earths were unobtainable. In conclusion, the author discussed the extent to which existing flame-proof apparatus met the requirements for various kinds of inflammable or explosive gases.

As the theme of the second paper, Mr. A. P. Young took "The Safety Training of Young Persons," pointing out that the incidence of accidents among those under eighteen years of age was usually much in excess of their proportion to the total number of employés, and that the greater percentage of such accidents occurred during the first year in a factory. The problem was essentially one of education, and called for recognition by the management and all grades of workers of the necessity for a planned co-operative effort guided by an educational campaign directed towards the inculcation of a subconscious safety sense in every member of the industrial team. Safety, efficiency, and tidiness were largely synonymous.

Mr. Young then described the safety organisation at the Rugby works of the B.T.H. Co. A committee representing the management, officials, and workmen met once a month to consider the development and maintenance of safety methods and to review accidents (placing responsibility for their happening) and to devise means of preventing their recurrence. A complete yearly analysis of accidents was also compiled. Boys were under skilled control in the training room generally for six months, and in addition attended weekly safety-first lectures by the apprentice supervisor, which were followed by tours of the works to impress upon them the importance of safe-working habits. Twelve different sports were provided in the club house and sports ground, and a full-time officer was employed as an active worker in the National Fitness Campaign. Young persons were not allowed to work on the most

dangerous machines, e.g., power presses, woodworking machines, and cranes. In addition to verbal instructions, booklets were issued containing hints on the avoidance of danger.

The success of the B.T.H. scheme was illustrated by figures relating to lost-time accidents. Thus, in 1928, when 9 million hours were worked, the frequency of reportable accidents was 2.64 per 10,000 hours; in 1937, with 15.7 million hours, the figure was 1.69, despite a large influx of young unskilled labour during the year. In 1927 the 145 young persons employed (4.2 per cent. of the total number of workpeople) were involved in 19 reportable accidents, which was 13.1 per cent. of the number of young persons. In 1937, when 540 were employed (8.2 per cent. of the total), there were 39 accidents, equivalent to 7.2 per cent. of the number engaged. Invaluable help had been received from the National Safety First Association and the Industrial Welfare Society in the form of experience, statistics, and posters. Mr. Young concluded by showing a talking film made in the B.T.H. research laboratory, which is to be exhibited to all employés at Rugby.

Overhead Line Routes. By J. L. Gaved

The need for accurate surveys

BECAUSE overhead lines are destined to be the chief system of electrical transmission and distribution for a good many years and because they have already been so extensively established, there is a greater need for an accurate and comprehensive survey of projected routes. An increasing unwillingness of landowners and tenant farmers to grant wayleave facilities is due to the cumulative effect of past errors in surveying routes.

There are numerous factors which have contributed to this state of affairs, *e.g.*, plant not erected according to the wayleave plan; damage caused during erection not being promptly investigated and paid for; hasty reference to compulsory powers; and inconsiderate treatment of tenant farmers by maintenance patrols. Disciplinary measures may be effective in the case of damage and annoyance by construction gangs or patrols and the effect may be minimised, while reference to statutory powers is generally the last desperate recourse to which a distributing authority is compelled and consequently it is not of frequent occurrence.

Plant which has not been erected in accordance with the plan is both a form of false pretence and an ever-present reminder of the fact to the owner and tenant. An obstructionist standpoint is very much in evidence upon any subsequent application being made to the aggrieved parties, especially in the case of large estates whose acres may spread over a very large area and consequently become the subject of numerous wayleave applications.

Much of this is, moreover, productive of increased costs both in constructional amendments and in annual rentals, the latter being a charge in perpetuity, for the owner may demand an adjustment of the route of the line after it has been at least partly erected or demand increased rentals for the fixtures.

Causes of Disagreement

The primary cause of any friction arising between the owners of the land and the supply authority in this manner is essentially that of inaccuracy of plans or, broadly speaking, inefficient procedure. The so-called preliminary survey is too often but the forerunner of many surveys if not so performed as to clearly define the position of each fixture. This definite survey should be preceded by a general access wayleave only and should itself precede any negotiations of the wayleaves proper. This clearly establishes the onus of responsibility on the surveyor and it should be upon his definition that the wayleave officer should proceed.

The "by-and-large" flexibility of many preliminary surveys is emphatically to be condemned. It has that illusory quality of getting up steam slowly, whereas there is no earthly reason for the absence of precision from the commencement of the work.

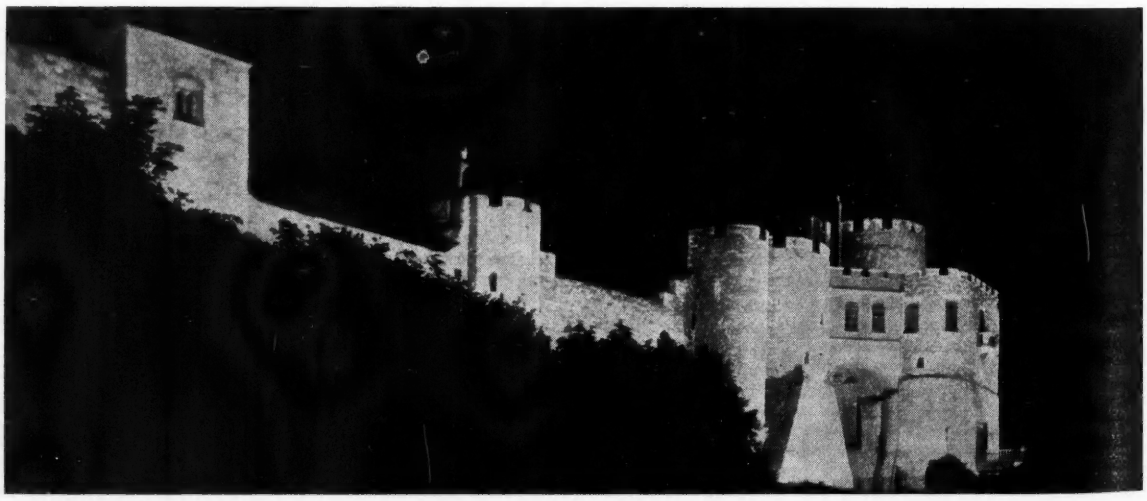
If the surveyor chains and levels a route in accordance with the best practice, having due regard to particular land values when a choice lies between arable and pasture land, good pasture and swamp, trees or a deviation, he is justified and should be encouraged either to peg the position of all fixtures or of all angle and straight-line sections. Further, he should particularly define the position of stays since these are far more objectionable in fields to farmers than poles or other standards.

Having pegged and plotted a route which more by the use of common sense than any technique of geodesy promises to be acceptable to all parties, he is in a position to hand a copy of his plan to the wayleave officer. The latter is then thrice armed in his negotiations with owners and tenants. He is the only individual who will come into contact with them and he can yet be quite positive concerning the whole of the fixtures which are to be erected and, in particular, their exact positions.

Accommodating Landowners

This officer rarely treads a path of roses along which each owner gladly gives immediate consent and signs along the dotted line. Nevertheless, he will certainly obtain a great proportion of the route on the first approach, since consideration of the land values has already been taken into account by the surveyor. In cases of objection to portions of the route he may refer back immediately to the surveyor, who can then pick out only those lengths affected, retaining the vast majority of the route intact and acceptable to the point of finality of positions. The owner, having declared his particular objection to the defined route, may then be accommodated in one interview on the site and again be presented with an accurate statement of fixtures.

The complement to this method of putting the wayleave officer wise in these details is for him to contribute information regarding the boundaries of individual owners along the route. He will, in some instances, be in a position from previous experience to declare which owners are prone to certain forms of objection. For example, one does not value trees, another doesn't care just what verdure is removed, while a third cries "hedges or nowhere" for fixtures.



Situated on the high cliffs to the east of the town Dover Castle is a notable landmark. At night it is effectively floodlighted with "Mercra" lamps in B.T.H. "Mazdalux" projectors and can be seen for miles around

Rural Network Protection. By T. C. Gilbert, A.M.I.E.E.

FALLEN overhead lines constitute a risk that has not yet been overcome, and reference to protection against this form of risk is made in the E.R.A. Report on "The Safety of Consumers in Rural Areas," where it is stated:—

"Earth leakage switches may also be used at sub-stations, as shown in fig. 5. The switches are pole mounted in weatherproof cases suitable for outside use. The earth connection is in parallel with the main earth and carries a proportion of the total current determined by the ratio of the impedance of the supplementary earth plus the trip coil to the impedance of the main earth."

The "fig. 5" referred to, which is reproduced under the same number on page 540, purports to give the usual connections of the device.

The Report further states, in connection with protective multiple earthing, that:—

"In order to protect against the danger of a voltage rise of the neutral conductor in systems using protective multiple earthing the sub-station leakage switch referred to (i.e., fig. 5) may be used. The switch operates in the same manner as domestic leakage switches except that instead of the trip coil being connected between the framework and earth it is connected between the neutral and earth."

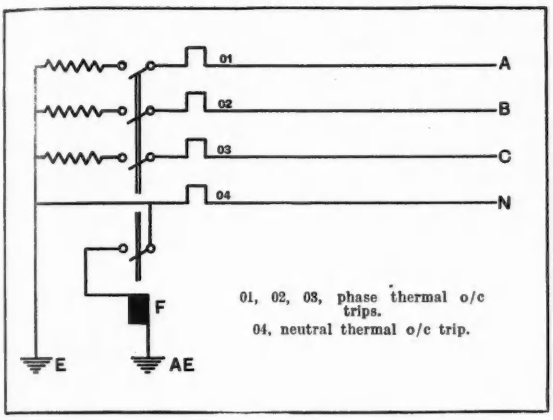


Fig. 1.—Sub-station switch for systems where the neutral is earthed at the sub-station only

Comparison with German methods

This statement would not be agreed to by the Continental engineers, who have developed *two* types of sub-station switch for rural network protection; one type (fig. 1) is for use where the neutral is earthed at the sub-station only, the other (fig. 2) for areas where the neutral is used for protection. Neither type bears any resemblance to fig. 5.

According to V.D.E. Regulation 0140, sub-station switches have been developed to prevent the *continuance* of an excessive voltage to earth on the load side of the lines. An excessive voltage is described as (1) more than 65 V on the neutral where neutral protection is used; 2) more than 250 V to earth on the lines; and (3) more than 125 V drop to earth on the protective earthing system of the low-voltage side in the event of connection to a high-voltage exceeding 250 V to earth.

In the systems shown in figs. 1 and 2, excessive voltages to earth may occur with: (1) A short-circuit between neutral and line; in such case the neutral overload trip must disconnect all lines, shown as 04. (2) The earthing of one line. In this case an excessive voltage to earth can occur both in the neutral line and in the remaining lines not in contact with earth, owing to the displacement of the neutral point. In 380-220-V systems, therefore, the earth leakage trip F must isolate the lines at least when the voltage exceeds 52 V, as when the neutral point is so far displaced by the earthing of one line that the voltage to earth of the other two lines rises from 220 to 250 V. (See fig. 3.) (3) By the entry of the high voltage into the l.v. side, in which case all conductors reach an excessive voltage to earth. The leakage trip F must switch out all poles of the system when 125 V is exceeded. Where the neutral is earthed at the sub-station only it is sometimes left intact, as in fig. 1, but the circuit through the trip coil is interrupted. Under V.D.E. Regulations it is sufficient if, in this case, the continuance of an excessive voltage to earth is prevented, *i.e.*, if the circuit breaker opens within 30 sec.

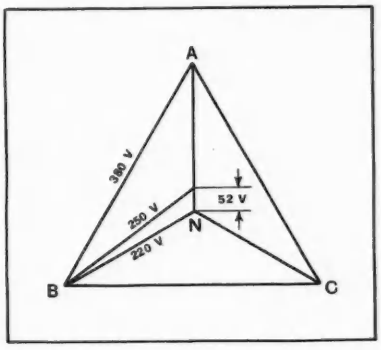


Fig. 3.—Neutral displaced by earthing of one line

Ratings for standard German equipment are 380 and 500 V and 60, 100, 200, and 350 A. It is recommended that overcurrent trips should not be designed for less than 25 A for the lines or 15 A for the neutral, in view of possible asymmetrical loading when heating apparatus is used. The V.D.E. Regulation 0660 demands the use of free-handle trips for all circuit-breakers on the system, including the leakage trip at the sub-station.

Sub-station switches must positively open all poles upon operation for fault or by hand, although means for separate isolation of each line for special purposes is permitted. The use of fuses at sub-stations is deprecated, since single-phasing of motors can only be prevented in the event of line short-circuits by equipment that opens all poles simultaneously, whilst in interconnected networks the use of circuit-breakers prevents the heavy asymmetrical loading resulting from short circuits. Whether the neutral is opened with the lines or not depends upon whether it is used for protective purposes. The E. R. A. Report suggests that the same switch can be used for both sets of conditions, which is contrary to German regulations. In the German device all trips, except those intended for operation on short-circuit, if any, but including neutral overload, phase overload and neutral potential trips, are arranged for delayed action and must function selectively.

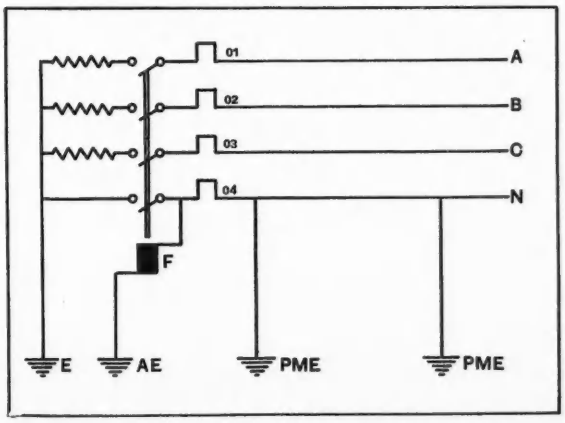


Fig. 2.—Switch for use where the neutral is used for protection (PME = protective multiple earths)

In nearly all cases, instantaneous overload trips impair the degree of selectivity secured in conjunction with protective devices that are connected on the load side, in that several series-connected trips or fuses may open unnecessarily, but this disadvantage is generally accepted in this country, attempts being made to counter it by means of graded fuses.

In addition, under German requirements, if several lines are connected to one transformer station, the high-voltage fuses or circuit-breakers connected on the primary side must not blow or trip when a heavy short-circuit occurs on one of the lines, as all lines are then made dead. The sub-station switches are sometimes equipped not only with the usual thermal overcurrent trips but also with instantaneous short-circuit trips, which in the worst cases disconnect only those lines over which they have control.

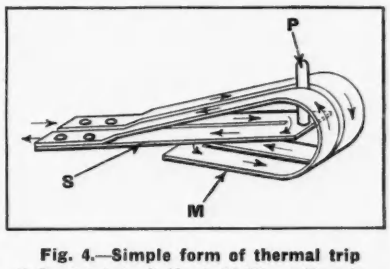


Fig. 4.—Simple form of thermal trip
P. Insulated pin. S. Shunt. M. Bi-metallic strips.

It is not permitted to effect tripping by means of normally

open-circuit trips dependent upon the line voltage, for the trip would fail to function should the voltage fall or fail. No-volt trips are rarely used, as they operate upon failure of the high-voltage supply. In general, thermal trips are used for overcurrent protection, and a magnetic trip for leakage operation. The switch here described is in use at about one thousand sub-stations, mainly in the Rhineland.

The thermal overcurrent trips connected in the lines are so

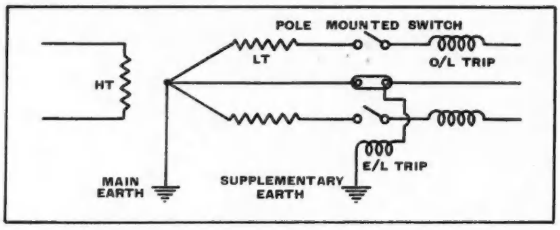


Fig. 5.—The switch illustrated in the E.R.A. Report

rated that with an ambient temperature of 20 deg. C., and a current exceeding the rated current by 5 per cent., tripping does not occur within two hours; with a current exceeding the rated current by 20 per cent. the circuit breaker must come into operation at some time within this period. The thermal overcurrent trips in the neutral are rated so that the ratio of the normal tripping current to the minimum tripping current does not exceed 1.75 amperes, the tripping time being 30 sec.

To allow for normal loading of the neutral during service the highest possible minimum tripping current should be aimed at for the neutral overcurrent trip. On the other hand, in view of the increase of the voltage to earth of the neutral due to loading, the lowest possible normal tripping current is desirable. A ratio of 1:1.75 for the minimum to the normal tripping current fulfils both conditions and makes it possible to employ an ordinary thermal trip for the neutral overcurrent device, without the backing of an instantaneous trip as may be used in the lines.

Example of Thermal Trip

One simple form of thermal trip with instantaneous device is shown in fig. 4. In this, the thermal strip is surrounded by a shunt, carrying a proportion of the total current passing. Under normal operation, the thermal strip is unaffected by the current in the shunt, but should this current become excessive, due to heavy short-circuit or overload, then the lower portion of the shunt repels the strip whilst the upper portion attracts it, causing it to spring upwards at a greatly accelerated rate, and open the switch by means of the insulated pin mounted on the thermal strip. In the complete switch illustrated in fig. 6 the phase thermal devices are rated

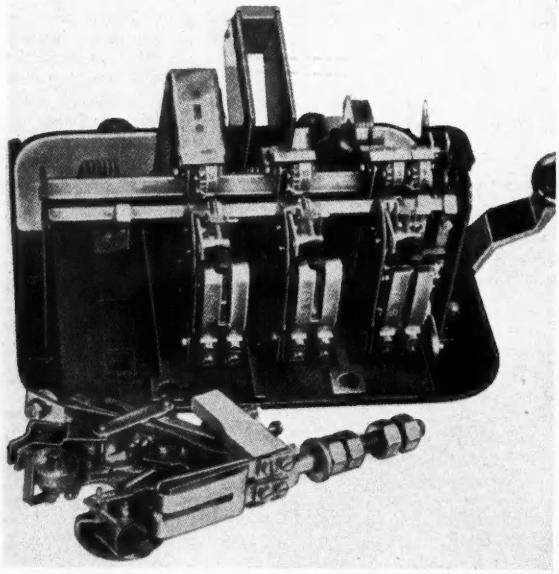


Fig. 6.—Switch incorporating the thermal trip

at 60 to 120 A, whilst the neutral thermal trip is not so equipped; the neutral overcurrent release is rated at 10 to 30 A. All the separate phase and neutral actions are self contained and easily removable; this permits of alterations for increase in load, or the reverse. The various trips are fitted with five numbered dials (phase overcurrent three, neutral overcurrent one, neutral potential one), whereby an indication is given of the cause of the switch coming into operation.

The leakage trip, or neutral potential release, is also arranged for delayed action, but as the current required to operate it is only 15 mA, it cannot be provided by thermal devices. The weight A (fig. 7) is balanced by the adjustable weight B, and upon the appearance of about 52 V upon the neutral line, the armature of the tripping coil C slowly but positively enters upon its travel, the mechanism eventually being tripped by the movement of the long shaft acting upon the release toggles.

Without series resistance the trip must not operate on test with 40 V, but with 50 ohms in series with the coil, and the application of 65 V, the tripping time must lie between 0.2 and 30 sec.; with 50 ohms in series, and the application of 125 V, the time must lie between 0.2 and 10 sec. All the rather intricate but necessary tripping details for ensuring selectivity or maximum efficiency of protection have been dismissed in the E. R. A. Report with the words "a time delay action is also sometimes used to prevent the switch operating on voltage rises of short duration." The most important aspect of the system, complete independence of bad earthing conditions at the sub-station site, has been ignored in the Report..

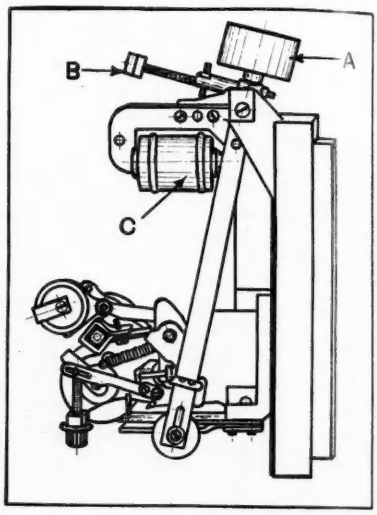


Fig. 7.—Method of securing delayed action

In some German sub-stations a similar switch to that described is used, but equipped for neutral overcurrent and neutral potential tripping only, phase overcurrent protection being afforded by fuses. I have noted these in the smaller stations, where possibly a few single-phase lines meet, and where the isolation of them all would not be of great consequence. They are often of quite moderate rupturing capacity, as they do not deal with phase overloads or short circuits. On the other hand, when sub-station switches incorporating phase overcurrent trips are used, which is in the great majority of sub-stations that I have visited, then the rupturing capacity is very heavy in view of the possibility of short-circuits near the station. The heavy blow-out coil for the dismounted action can be seen in fig. 6.

Extensive Use in Germany

The use of fuses does not permit the close protection afforded by thermal overcurrent devices, nor can the lines be loaded to the same degree of efficiency, and for this reason they are rarely found in the German sub-stations in the area mentioned.

Many of the sub-station switches described have been in use for nine years in the R. W. E. areas, which means practically the whole of the Rhineland from Baden to the Dutch border. The only refinement that has been found necessary is the fitting of external self-reclosing gear in some districts, where lightning is frequent. My informant as to the number of switches now in use, over one thousand last September, was the late Herr Riedl, who was responsible, with Herr Heinisch, for the full development of the system.

The paragraph quoted at the commencement of this article, incorporating fig. 5, is marked with an asterisk in the Report, and a footnote makes reference to my book on the subject; no diagram bearing even a slight resemblance to fig. 5 will be found in that publication, however, nor can the statements made be justified by reference to it. If the intention of the Report was to deal with the fig. 5 switch only, to the complete exclusion of the German device, then I feel that a reason should be given for its unsuitability for conditions in this country. The omission is difficult to understand as a complete handbook, in English, has been available for over a year, whilst my own book has contained the fundamentals of the system since 1932.

Lighting Service

The latest reconstruction of the E.L.M.A. Bureau

IT is the practice of the Electric Lamp Manufacturers' Association to make substantial alterations each year in its Lighting Service Bureau at 2, Savoy Hill, London, W.C.2. By this means the latest ideas in illumination can be incorporated in the display and improved methods of inculcating the gospel of better lighting can be introduced.

The Association regularly reconstructs a third or a quarter of the apartments each year; this year's improvements (for which the Bureau's architect, Mr. R. O. Sutherland, is responsible) centre largely upon the new lecture theatre. The continued increase in the number of people attending the Illumination Design Courses has made greater accommodation imperative, and the new theatre is capable of holding about 300. A considerable addition can be made at need by the removal of the back partition which throws in the committee room; the latter is itself a new and larger apartment.

At the other end of the theatre is a commodious stage with an opening the width of the theatre. For this stage special lighting, operating in conjunction with a barrel ceiling, has been installed, and the result is excellent; a speaker is not subjected to inconvenient shadows and the auxiliary lighting gives even illumination of the demonstration features and devices upon the stage.

The theatre is equipped with a remarkable series of lighting systems which can be demonstrated separately or in combination. They embody industrial units, totally enclosed fittings and discharge-lamp lighting. The last-mentioned units are brought up to running intensity before the demonstration and are equipped with shutter devices which enable them to be exposed instantaneously when required. The indirect lighting system, giving a uniform intensity of 70 ft-candles, demonstrates how restful and comfortable to the eye this method can be.

Surrounding the auditorium is a new form of louvred cornice providing both direct and indirect lighting, and at the same time acting as a decorative medium. Another ingenious feature is a ceiling panel in colours upon which screwed tubing is arranged in a geometrical pattern. At the bends ordinary lamps with silvered bases are fitted and the whole when illuminated is highly decorative. This method of dealing with otherwise unsightly conduit is certainly to be recommended.

Altogether the theatre is equipped with five distinct industrial lighting arrangements and three commercial installations, and there is an upper limit of 160 ft.-candles of general lighting.

The new committee room when not being used as such is brought into service for the demonstration of school lighting. As it is about the size of the normal classroom it provides an excellent means of showing educational authorities how such a room should be treated from the lighting aspect. A classroom atmosphere is provided by a collection of interesting charts mounted on the walls which deal with the effect of lighting on the eye, and illustrate the principal activities of the Bureau.

Shop and display lighting have received particular attention in this reconstruction and some striking examples of "selling by light" have been arranged, largely inspired by American methods seen by Messrs. Jones & Lingard during recent visits to the United States. The principal innovation is an attractive modern shop front comprising a well-lighted window display and a façade of glass bricks illuminated from behind with very effective results. An open show-counter with incorporated lighting is another idea which possesses great possibilities, and the lighting of a modiste's model shows what can be done in the way of concentrated lighting to draw attention to individual displays.

Apart from the demonstration side, the other arrangements at the Bureau have been improved for the benefit of the greatly-increased number of people who visit the Bureau nowadays.

In the course of a Press visit to the Bureau last week, Mr. C. W. Sully, director of E.L.M.A., referred to the recent reductions in lamp prices and maintained that the lamps made by the members of his Association gave that reliability which was what the customer wanted. They hoped that the reduction of the price of the 75-W lamp to the same level as that of the 60-W size would lead to a general step-up in illumination values.

1. A view of the new lecture theatre at the Lighting Service Bureau.
2. The shop-lighting demonstration room, with lighted display counter.
3. An attractive shop front

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Mr. W. J. Jones, manager of the Bureau, said he calculated that the introduction of the electric-discharge lamp three years ago had given the electricity supply authorities about £500,000 extra revenue. He also maintained that the extra efficiency of the coiled-coil lamp had represented a "lighting bonus" to users of about a million pounds.

The first of this season's Illumination Design Courses opened on Monday last, and so great was the rush of applications that many had to be disappointed. To cope with the numbers of people in various branches of the industry who wish to take the courses it has been found necessary to organise them in a number of provincial centres.

Copper Earthing Electrodes

Driving tests in various kinds of soils

A DEMONSTRATION of the driving of earth electrodes by means of an electric hammer was arranged on October 5th by the Copper Development Association and the Mansions Motor Co., on sites arranged by the North Metropolitan Electric Power Supply Co. The first series of tests was made at Ringslade Road sub-station, Wood Green, where the ground is formed of London clay. Hard-drawn copper rod of ½ in. diameter was selected for the initial experiment and its entire 8 ft. was sent down into the soil in 2 min. 45 sec. A resistance test from its head to the main body of the earth gave a figure of 3 Ω.

In this and in subsequent tests, it was noted that the rod was not burred by the action of the "Kango D-type" hammer which converts by centrifugal action the rotary motion of an electric motor into 1,400 light blows per minute. At the outset, when the high end was out of reach, the weight of the hammer itself resting vertically on the top of the electrode effectively supplemented the effect of the blows; later in the descent the weight of the operator was added. The motor had an input of about 450 W and was of the 200-250-V universal type. The hammer does not start work until it is pushed on to the end of the electrode, so there was no risk of idle blows causing damage.

A ½-in. bore 18-gauge copper tube, also 8 ft. long, was then driven in 4 min. 30 sec. and a resistance to earth of 2.8 Ω was obtained. Next a ⅜-in. h.d. copper rod, 6 ft. long, required 40 sec. and gave a value of 4.2 Ω. An 8-ft. length of ½-in. "Copperweld" rod, supplied by the British Insulated Cables, Ltd., took 1 min. 40 sec. and showed 2.9 Ω to earth.

The next demonstration at Langley End proved more difficult, as the ground was composed of chalk and hard limestone with large and numerous flints. In neither of the first two trials could 6 ft. of ⅜-in. or 8 ft. of ½-in. copper rods be driven the whole of their lengths. In the latter case, 1 ft. remained above the top soil and the reason was found on excavating 2 ft. 6 in. out of the side of the quarry by means of the "Kango." The electrode, after going straight down for 4 ft., had encountered a hard piece of limestone which it had evaded by going off at an angle of 30 deg. from the vertical. Afterwards rocks had diverted its path into an almost horizontal direction until it was ultimately pulled up by butting against a large flint. Had it been half an inch lower, it is possible that it would have evaded this obstacle and continued its serpentine course. Three other tests here, however, gave positive results. An 8-ft. copper tube, ½-in. bore and 18 SWG with its top protected from belling by a screwed steel socket, took 1 min. 45 sec. to disappear, while a "Copperweld" rod of the same dimensions took 1 min. 25 sec.

A special exhibition of what could be done by this method of driving was then staged at the "Three Hills" sand and gravel pits, Codicote, when 45 ft. of ½-in. "Copperweld" rod was driven as one electrode. The rod was in six 8-ft. lengths, each connected to the succeeding one by a screwed socket, until progress ceased, leaving 3 ft. projecting from the soil. The times taken for each section were: 45 sec., 1 min. 50 sec., 1 min. 35 sec., 1 min. 40 sec., 2 min. 30 sec., and 3 min. The resistance to the main body of the earth of the first length was 1,440 Ω and of the second 80 Ω. Thereafter the measurements increased and decreased erratically, due no doubt to the connecting sockets being of larger diameter than the rods and thus disturbing the intimate contact between the latter and the soil. The final demonstration consisted of driving 8 ft. of ½-in. commercial copper wire purchased haphazard from an ironmonger's stock. The time taken was 35 sec. and the resistance to earth was 88 Ω.

It is claimed that a ½-in. diameter copper rod or tube can be driven into the ground with the expenditure of only about one-quarter of the energy required for a 1-in. steel water pipe, while their prices are strictly comparable with those of steel electrodes. Moreover, the life of copper rods owing to their resistance to soil corrosion may be anything up to fifty times that of a steel electrode of similar size, according to tests made in the United States by the Bureau of Standards and discussed together with other aspects of the subject in a new publication issued by the Copper Development Association entitled "Copper for Earthing."

A third reason advanced for the use of copper is that corrosion likely to occur when clamping a copper conductor to a ferrous electrode is avoided.

Further information on the driving of earth electrodes by electrical means and a discussion of the relative advantages of using a single long electrode and several short rods in parallel was contained in an article contributed by Mr. H. G. Taylor to the ELECTRICAL REVIEW of August 26th.

Left: Driving a ½-n. by 8 ft. copper earth electrode in London clay. Centre: A 16 ft., ½-in. diameter coupled copper electrode being driven horizontally in gravel. Right: An electrode (8 ft. by ½in. diameter) piercing limestone at Langley End

Films for Engineers

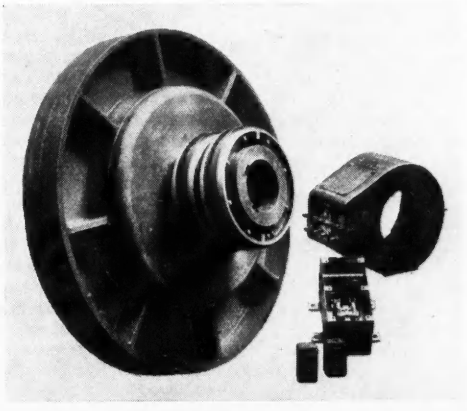
THE Stanton Ironworks Co., Ltd., has a number of films which it is prepared to lend free to interested societies and organisations. One of two recently completed illustrates in detail the manufacture of Stanton centrifugally made concrete pipes, from the inspection of raw materials to the testing of the finished pipes, while the other shows the manufacture of Stanton reinforced concrete lamp standards and other concrete products such as kerbs and slabs. Other films illustrate the manufacture of Stanton pig-iron and the manufacture of spun iron pipes. There is also a single film showing both these processes in rather less detail than the separate films. Further films are in preparation, including one on the company's continuous casting plant at Holwell and one on the assembly of the various types of pipe joint. All the films described are 16 mm. silent films. Each is approximately 400 ft. long. Secretaries of engineering societies and similar organisations who wish to borrow any of these films should write to the company for details of dates on which they are available during the coming winter.

Magnetic Torque Limiters. By H. E. Hutter

The magnetic clutch is already appreciated for its reliability in operation and its various advantages over other types of mechanical clutch, but the magnetic torque limiter is less widely known, especially for high powers.

MECHANICAL slip couplings consist essentially of one or more friction linings held under pressure between plates, the actual pressure being applied by springs which are provided with means for adjusting the tension and therefore the torque at which the coupling will slip. The amount of slip allowable depends on the heat capacity of the coupling, since an excessive amount of slip will result in overheating and possibly the destruction of the friction surfaces. Because of these restrictions, for the largest sizes it is to the magnetic coupling that attention must be given. This does not mean that the magnetic type is unsuited for small powers, but it suffers a disadvantage due to increased cost.

An example may be quoted of a slip coupling recently manufactured which was designed to transmit a torque of 25,000 ft.-lb. normally, which was subject to an increase due to overload up to 27,500 ft.-lb. In the case of accident or jam on the machine the torque available from the motor would exceed 60,000 ft.-lb., due to the fact that the cycle of operations is such that the motor has to reach a speed of 600 r.p.m. and reverse up to a maximum of 180 times an hour, the extra power being required to accelerate the motor armature. The application of this total power to the driven machine and gear box would result in their destruction as they were only designed to be suitable for peaks of 30,000 ft.-lb. To protect the remainder of the plant a slip coupling was interposed between the motor and first gear box, slipping at a torque of 30,000 ft.-lb.



Rear view of 44-in. body with slip rings

The main body which carries the magnetising coil, slip rings and friction linings is seen on the right of the illustration of the complete unit, while the armature and its hub is on the left. The maximum diameter of the coupling is 54 in. and its weight about 2 tons. Electrical control is provided and the contactors with their discharge resistances are mounted in a welded steel case.

The actual setting of the slipping torque is effected by a series resistance in circuit with the magnetising coil. The torque is transmitted by the pressure exerted on the friction linings by the armature, the actual pull being determined by the ampère-turns of the coil and the air gap. In this case the clutch is engaged when stationary and so the only wear on the lining will be when slip occurs; the air gap can therefore be considered constant. The ampère-turns of the coil can be controlled by the series resistance. It is of the utmost importance that the slipping torque be maintained at a constant value and not fall off after the coil has heated up, and the permissible heating of the coil must be strictly limited, as any increase in coil resistance due to this will cause a drop in current and consequently torque.

Two clutches of this type have been installed on a marine dredger for coupling 550-h.p. Diesel engines to pumps. In this case the clutches pick up the load when the engines are running at full speed and the pumps are stationary. Push-button control from the bridge is employed and the torque transmitted by the clutch is controlled by a series resistance in a similar manner to the example which is described above.

In the event of a pump jam it would be possible for the clutch to slip for a considerable period without being noticed, which would result in the linings being destroyed, as they would soon reach a dangerous temperature at which the rate of wear becomes very heavy. To avoid any possibility of trouble of this sort thermostats have been built into the friction linings and their setting has been so selected that they will open before a dangerous temperature has been reached on the rubbing surface.

The thermostats are connected with the actuating coil circuit of the operating contactors so as to open the clutch circuit on the predetermined temperature being attained and, further, will not allow the clutch to be engaged again until a suitable temperature has been reached. The connections to the thermostats are taken through an extra pair of slip rings.

Due to the size and weight of these equipments special attention is given to the question of replacements, the friction linings are mounted on to steel plates attached by studs to the outer ring of the clutch, these rings being divided so that a new set of linings can be fitted in a few minutes.

The current collecting slip rings of these limiters are also divided for ease of replacement. Unlike any other type of clutch, these are the only two parts which can be subjected to wear.

Left: A complete 54-in. torque limiter. Below: A body for a 44-in. clutch and limiter

French Safety Label for Radio Sets

THE Union des Syndicats de l'Electricité, whose " U.S.E. quality label " has for several years past been used for a very wide variety of electrical apparatus, has drawn up plans for a " safety label " for radio sets. This label, which is to be granted to manufacturers on the same general grounds as the " quality label " for other articles, will cover only the electrical safety of the set for the present. Quality specifications are, however, under consideration, and should the " safety label " prove a success, further specifications will be drawn up and the quality label extended to radio sets.

Oxidation of Contacts. By G. W. Nicholson

Effect on silver and its alloys

THE formation of oxides on metal contacts and the rate of oxidation are largely dependent on heat generated in the apparatus. The heating usually present under normal operating conditions is sometimes sufficient to start oxidation, and the higher the resistance of an oxide film the greater is the heating set up. When a current is broken the induced voltage is higher than the normal and an arc is generally produced; if the resulting temperature is high enough to melt the contact metal oxidation may be very rapid.

Silver melted in air absorbs a large amount of oxygen, forming a solution of oxide in the molten liquid. On solidifying, however, most of it is forcibly ejected from the metal by the process known as "spitting," very little, if any, remaining in the silver. It is only when solidification takes place under high pressure that silver oxide is retained in the metal. Spitting leaves a blistered surface and, even if the contact has only suffered slight surface melting, the roughness sets up excessive heating and ultimately the apparatus is ruined. At temperatures below its melting point silver is completely resistant to oxidation. Its low melting point (960 deg. C.), however, is one of the factors that limit its use and, although it is in extensive demand as a contact metal, in practice its employment is chiefly confined to cases in which there is little or no arcing.

Silver alloyed with gold up to about one-third of its weight retains the property of absorbing oxygen when melted and that of spitting on solidifying, but the addition of only 2½ per cent. copper to silver prevents spitting. The immunity of silver to oxidation below its melting point has led to the practice of silvering the surfaces of contact metals which normally oxidise freely.

Most of the silver alloys used as contact metals are to varying extents subject to oxidation and with some even atmospheric conditions can start oxide formation with resultant destructive effects. Initial oxide films are so thin as to be invisible, the first sign of action being "tinting." A series of colour changes takes place as the action proceeds until sufficient thickness of oxide is built up to show its characteristic colour. The colours during tinting provide indications of the thickness of the film, but can only be taken as a rough means of measurement, as the thickness often varies considerably and is seldom uniform over the surface.

After a definite thickness of oxide has been built up, "cracking" may take place and the oxidising action accelerated by the free movement of oxygen thus allowed through the cracks. At first the cracks are so small as to be invisible, but as the oxide thickens they widen and oxidation becomes more rapid.

Because of the non-oxidising property of silver below its melting point, a binary silver alloy is not subject to the various oxidation complications common to other alloys in which the oxides of the different metals may, or may not, form a solid solution, or when one oxide may be in excess of another and only partly miscible. Tertiary or quaternary silver alloys are not free from the possibility of such complications although under normal conditions the silver does not enter into any complication.

Contacts are generally more subject to oxidation when vibration is present, as it often is in certain classes of electrical apparatus. Moisture has the effect of accelerating oxidation, especially after a definite thickness of oxide has been built up. Line contact lessens the tendency to oxidation, as the electrical resistance between the two bodies is less. As pointed out by Holm ("Uber Elektrische Kontakte," May 7th, 1935) surfaces cannot be prepared well enough to form perfect contact. Between two surfaces there is actually a series of point contacts and, therefore, the resistance between flat surfaces must necessarily be greater than with a line contact. Mechanical pitting of contacts, common with silver and some silver alloy contacts, brings about a noticeable increase in resistance with resultant heating and often oxidation. With line contacts the danger of pitting is not so great.

The addition of platinum to silver raises the melting point and increases hardness, and this alloy is highly resistant to oxidation both under atmospheric and the severest working conditions. Its impact value is high and there is therefore little danger of pitting. The addition of gold to this alloy has little effect on oxidation. Palladium alloyed with silver has a high melting point and good resistance to oxidation, so that an alloy of 70 per cent. silver, 25 per cent. palladium, 5 per cent. cobalt is very often used for its oxidation resisting qualities.

Standard silver, which is an alloy containing 7½ per cent. copper, is much harder than pure silver, has greater electrical resistance and is subject to atmospheric oxidation which is greatly accelerated by heat. Its melting point is 894 deg. C. and at a temperature well under this a thick scale of oxide is rapidly formed. The resistance of a silver alloy to oxidation can be increased by oxidising its surface a few times and cleaning and polishing after each process. The resistance appears to result from the removal of the base metal in the form of oxide from the surface of the alloy, leaving the surface near to pure silver. Silver alloy contacts with a wiping action thus have an increased resistance to oxidation, through being cleaned each time they operate.

I.E.E. Arrangements

IN addition to the London meetings of the I.E.E. announced in our last issue, the annual dinner will be held at Grosvenor House, Park Lane, W.1, on February 9th, and the annual general meeting will be held on May 11th. The thirtieth Kelvin lecture will be given by Prof. P. M. S. Blackett on April 27th, his subject being "Cosmic Rays."

The Wireless Section meetings commence on November 2nd, when Mr. A. J. Gill (chairman) will deliver his inaugural address. On December 7th Messrs. E. C. Cork and J. L. Pawsey will present a paper on "Long Feeders for Transmitting Wide Side-Bands, with Reference to the Alexandra Palace Aerial-Feeder System," and Dr. J. D. McGee and Dr. Ing. H. G. Lubszynski will give a paper entitled "E.M.I. Cathode-ray Television Transmission Tubes." Sir Noel Ashbridge will give a lecture on "Broadcasting and Television" on January 4th.

The chairman's address, which will be delivered by Capt. B. S. Cohen before the Meter and Instrument Section on November 4th, will deal with "Protective Devices for Telecommunication Purposes." The Section dinner will be held at the Holborn Restaurant on November 18th, and on December 6th there will be a discussion on "Electro-Acoustics," which will be opened by Dr. C. V. Drysdale. This will be a joint meeting with the Physical Society. The first meeting in the New Year will be held on January 6th, when Dr. E. G. James and Messrs. G. R. Polgreen and G. W. Warren will present a paper entitled "Instruments Incorporating Thermionic Valves and their Characteristics."

The conversazione and dance of the Transmission Section will be held at the Criterion Restaurant on November 2nd. On November 9th Mr. S. R. Siviour (chairman) will deliver his inaugural address and on December 14th Prof. J. C. van Staveren will give a lecture on "The Organisation, Work and Laboratories of the N.V. tot Keuring van Electrotechnische Materialen (K.E.M.A.), the Dutch Testing Station for Electrical Material." The first meeting in 1939 will be held on January 18th, when a paper on "Long-Period Ageing Tests on Solid-Type Cable" will be presented by Messrs. T. R. Scott and R. C. Mildner.

One of the first actions of the new President of the Institution of Electrical Engineers, Dr. A. P. M. Fleming, who took up his duties on October 1st, has been to write a circular letter to the members regarding the state of the Benevolent Fund. In 1937, for the first time, the Fund was faced with a deficit. Help in cases that deserved consideration had to be refused and the Committee of Management was placed in the difficult position of having to discriminate between equally needy applicants. The appeal is made especially to the 70 per cent. of the membership who at present subscribe nothing to the Fund, but the hope is expressed that the 30 per cent. who do so will increase their support if they can.

E.A.W. Activities

SINCE the inauguration, in 1936, of the Electrical Association for Women's campaign to help solve the domestic servant problem, about a hundred courses have been held and 299 certificates have already been awarded, while in one centre alone 110 candidates are awaiting examination. This statement was made by Miss Caroline Haslett, director of the E.A.W., at a meeting held at the Woolwich Polytechnic last Friday to inaugurate the home workers' classes which are being held at the Woolwich Electricity Showrooms, under the auspices of the L.C.C. Dr. Mallett, principal of the Polytechnic, presided over the meeting, and Mr. F. F. Elliott, borough electrical engineer of Woolwich, expressed his appreciation of the classes.

Sir William Beveridge, Miss Haslett, Mr. H. G. Fraser (manager, City of Oxford Electricity Department) and Mrs. Wickham Steed (president of the branch) will speak at the inaugural meeting of the Oxford branch at the Town Hall next Monday.

The annual luncheon of the Plymouth Branch was held last Friday. Lady Astor (president of the branch), Lady Brooke, Mr. J. T. H. Legge (C.E.B.), and Mr. H. Midgley (city electrical engineer) were among the 116 present.

Meetings and Discussions

The 1938-39 session of the institutions and associations connected with the electricity industry has now commenced. The opening meeting of the Institution of Electrical Engineers is to be held next Thursday when Dr. A. P. M. Fleming will deliver his presidential address. We give below reports of some addresses and papers which have been presented during the past week or two covering a variety of subjects.

Telecommunication Services

TELEGRAPH, telephone and cable developments were reviewed by Mr. H. Faulkner (superintending engineer, North Wales district, G.P.O.) in his inaugural address as the chairman of the South Midland Centre of the INSTITUTION OF ELECTRICAL ENGINEERS at Birmingham on October 12th.

Mr. Faulkner indicated how experimental apparatus had shown the practicability of automatic switching in telegraph circuits, which would avoid retransmission, undoubtedly speed up the service and, at the same time, effect very considerable economies in operation.

The maximum number of links in a through connection would be limited to two voice-frequency channels and two physical extensions, or three voice-frequency channels and two physical extensions having negligible signal distortion. The switching centres would be connected by a network of main links or trunks consisting of voice-frequency channels. The introduction of the switched system would involve an increase in the number of voice-frequency channels, the introduction of new voice-frequency terminals and an increase in the number of circuits from switching centres to minor offices. In the final scheme, the country would be served by some twenty-five switching centres and they would be so interconnected that alternative routes would be available on all calls. Since the teleprinter positions would not necessarily be permanently staffed, the teleprinters would be fitted with answer-back units to indicate the maturing of a call and the code of the office to which connection had been made, with an alarm to indicate when the paper failed to feed correctly.

Cables

The principal cable development had been the application of high-frequency technique. Apart from the co-axial cable system recently installed on which a number of circuits were worked from London to Birmingham, two such concentric cables with "Paragutta" insulation had recently been laid for the Post Office by Submarine Cables, Ltd., across the Irish Sea from the North Wales coast at Nevin to Howth in Eire. "Paragutta" was a new insulating material prepared by a special process from balata rubber and refined wax, which had the necessary qualities of strength and permanence together with electrical qualities which made it specially suitable for submarine work. The method of working this type of cable was very similar to that employed in other carrier circuits, but it was impossible to provide repeater stations at close intervals along the route and terminal repeaters had to be developed to give greater amplification than was normally necessary. The amplifiers were of the negative feed back type having an amplification of 60 db. It was proposed to work the "go" circuits on one cable and the "return" circuits on the other, the cables being separated by a distance sufficient to keep the cross talk, which was greater at the lower frequencies owing to the reduced screening efficiency, within the required limits for satisfactory working. Owing to the greater amplification necessary greater separation was required than in the case of land-line circuits. The two cables would provide 16 four wire circuits between Nevin and Dublin, one of which would be utilised to give eighteen telegraph channels.

Future progress in carrier wave transmission would probably be realised by the use of hyper-frequency wave-guides. In this system electromagnetic waves were sent through "guides" which might consist of an insulator surrounded by a conductor, or even of an insulator alone. A particular feature of some forms of this method of electrical propagation was that the attenuation decreased with frequency, a fact which might prove to have great significance in connection with the transmission of television over cables, and for use in the main telephone trunk network.

Telephone transmission limits, the routing of traffic in relation to line losses and modifications in exchange design were next referred to, after which Mr. Faulkner outlined the progress made with ultra-short-wave radio-telephone links with outputs of from 1 to 250 W, crystal controlled. The transmitters were exceedingly compact and took up little more room than an ordinary broadcast receiver. A receiver of the superheterodyne type having a crystal controlled oscillator was used as standard. Multi-channel working was now resorted to and arrangements had been made to provide nine circuits with one transmitter and one aerial system. Plans were proceeding to provide a radio link of this type between the Isle of Man and Holyhead. It had been decided to install at the outset six transmitters capable of giving an output power of 100 W each in order to avoid the necessity of replacement of low-powered transmitters when multiplex working was required on these links. The transmitters would be under-run initially. It was hoped that by the time the 12-channel line carrier system was ready for establishment on the circuits to the island it would be possible for the radio equipment to accept the 12-channel line signals for direct transmission without the need for prior demodulation to audio-frequency as was the case at present.

Apparatus had also been developed for radio-phonogram working between outlying islands in the north of Scotland and the mainland and elsewhere; for this the same apparatus was used for transmitting and receiving, suitable switching arrangements being provided. The apparatus had been called a "Transceiver." Such circuits had been established between Lewick and Skerray, Sandness and Foula, Sandness and Papa Stour, Hewna and Stroma, Soay and Elgol, normal cable communication being out of the question on economic grounds.

The development of instruments for testing and checking purposes now permitted telephone communication to be engineered on a definite measurement basis, which was having a very marked effect on the quality of service given to the subscriber, while the improvement of the quality of speech was also receiving attention.

Finally, Mr. Faulkner drew attention to the electric light and power requirements in Post Office buildings. For instance, the wattage of lamps installed exceeded 20 million and some 26 million kWh was delivered from Post Office transformer stations, while there were very many kinds of electrically driven appliances to be maintained.

Diesels at the B.B.C. Stations

TWENTY-FIVE Diesel engines with an aggregate b.h.p. of 12,360 are installed at the high-power regional transmitting stations of the British Broadcasting Corporation. The first five contain four engines each, of which three running at 70 per cent. of full load carry the demand of the transmitters, and the fourth acts as stand-by. In a paper on the maintenance of this plant read before the DIESEL ENGINE USERS' ASSOCIATION on Wednesday last, Messrs. L. Hotine and P. H. Smyth state that reliable operation at low cost depends primarily on the use of clean lubricating oil (the less the oil consumption the less the cylinder wear) and an efficient cooling-water system. Hard water from the London chalk bed produces scale deposits which have caused cylinder covers to crack through over-heating. Liners are withdrawn for painting on the outside with graphite paint to prevent close adhesion of scale and also to renew lower rubber rings making the water-tight joint with the frame, which perish, due to oil thrown off the cranks.

Engines are thoroughly overhauled every 4,000 hours. The earlier are of the ante-combustion chamber type and the later of the direct injection type; the former are less efficient thermally, cylinder wear is more rapid (0.0025 in. per 1,000 hr.) and pistons stick earlier. With fixed piston pins, lubricating oil consumption is considerably less than with floating pins. Oils of widely differing specification have varied little in their effect on cylinder wear, though they do in regard to sticking rings, but oils with the same specification have given widely differing results. The authors dissent from the view that growth of cast iron cannot take place below a temperature somewhat above 200 deg. F. They suggest that the piston body temperature between rings and gudgeon pins is less than 160 deg.; yet they have always found growth under the rings amounting to a maximum of 0.001 in. in 10,000 hours.

Plastics in Engineering

A PAPER dealing with "Plastics" was read before the INSTITUTION OF MECHANICAL ENGINEERS at Sheffield, on September 28th, by Mr. H. V. Potter, managing director of Bakelite, Ltd. The author dealt mainly with synthetic resins or resinoids and referred to the increase in mechanical strength due to the incorporation of fillers, outlining the methods of

producing bakelite moulding and laminated materials, and explaining their physical properties. He said that compared with moulded bearings laminated materials possessed superior tensile, impact and cross-breaking strength. Laminated fabric material had a better impact strength than cast-iron and a specific gravity of 1.32 to 1.38 as compared with 6.9 to 7.5, this considerable reduction in weight offsetting somewhat lower tensile and cross-breaking strength figures.

Bearings made from resinoid products could usually be employed wherever bronze, white metal or lignum vitæ had previously been used. Above a temperature of 150 deg., however, the cotton fabric base would probably become charred. Resinoid bearings could be lubricated by water. Their use had been found to result in a lower power consumption and longer life.

Many drives did not require gears made from exceptionally high tensile-strength materials or cut to precision limits, in which cases laminated materials had advantages. Their power capacity was comparable with that of cast-iron, and their low weight permitted the use of peripheral velocities up to 3,000 ft. per min. in ordinary practice, but up to 7,500 ft. per min. with good bearings and rigid mountings. The natural resilience of the materials enabled them to withstand shock loads and absorb any effects due to inaccuracies in commercial gear cutting. The principal advantages claimed for them were that they possessed an unusual toughness for organic materials with good wear resistance and high stability, that they remained unaffected by atmospheric conditions, water, oils, steam, acid fumes and heat up to 250 deg. F., and ran more silently than metal gears.

Colliery Engineers

THE first meeting of the 1938-39 session of the South Wales branch of the ASSOCIATION OF MINING ELECTRICAL ENGINEERS was held at Cardiff on October 8th. In his inaugural address the new branch president, Mr. Joseph Jones, referred to the sincerity of purpose which characterised the Association's endeavours. From the first it had attached considerable importance to technical and practical capabilities and, in addition, realised that colliery electrical engineers needed to be skilled mechanical engineers. Modern mining conditions required conscientious supervision by engineers with specialised training and ripe experience. Such control could only become effective when it had the requisite confidence of the management, enabling the necessary authority to be delegated. The engineer combined some of the functions of the scientist with the skill of the mechanician. He must not only know what was theoretically possible, but also whether it was commercially and economically practicable.

Too often, said Mr. Jones, had colliery engineers buried their heads in the sands of technical problems with a complete disregard for the broader view. The policy of an industry was not dictated by technical difficulties, but by economics, and it was important, therefore, that engineers should, without necessarily becoming masters in the technique of the economist, learn to appreciate in what way the teaching of economic science could help in the solution of problems.

Transport Co-ordination

IN the course of his address as president of the INSTITUTE OF TRANSPORT on Monday last Mr. Gilbert S. Szlumper, C.B.E., urged the necessity for the co-ordination of public transport. He pointed to the London Passenger Transport Board as a "bold experiment" in this direction. He said that the Board had eliminated much wasteful competition and had extended and improved travel facilities in the London area. He went on to say:—"The question of adequate revenues appears to be rather more obscure for, as I see things, the development of London and the population of its suburbs has been allowed to take place without any thought for the future, and it is only recently that official opinion has begun to awake to this fact, and it well may be that in the course of time the L.P.T.B. may have to undertake works of considerable magnitude which themselves cannot be remunerative but which will be necessary if the traffic needs of London and its outlying parts are to be met in a satisfactory manner."

He suggested that similar boards should be set up in other suitable areas where the traffic was heavy. Whatever form of co-ordination might materialise it was certain that the cost of providing and operating the various forms of co-ordinated transport must be very carefully inter-related and must govern the provision of further facilities.

Correspondence

Every letter must be accompanied by the writer's name and address preferably, but not necessarily, for publication. The Editors cannot accept responsibility for correspondents' opinions

The Plug and Socket Problem

ACCORDING to his article on standardisation in your last week's issue, Mr. Waite appears to have had a series of unfortunate experiences when changing his residence four times, but it would be interesting to learn how it came about that he had to change the plugs on each removal. In view of his other remarks one may presume that it was not because he himself prefers flat-pin plugs and that each new house was fitted with round pin socket outlets. There remain, therefore, two alternative explanations: either he uses round-pin plugs of B.S. dimensions and the new houses were fitted with flat-pin socket outlets (in which case one must conclude that flat pins are in more general use than most people imagine) or the new houses had round-pin socket outlets which were non-standard and would not take the standard plugs which Mr. Waite brought with him.

The last explanation is probably the correct one, and, if so, does it not rather lead to the conclusion that the real cause of his troubles is not that there is no standard for the round-pin type but that so many plugs and sockets do not conform to it? That is a point which he has not sufficiently emphasised in his article and in this connection the manufacturers are not altogether free from blame. It has certainly been a more fruitful cause of trouble to consumers than the fact that there are two types of plug on the market.

Mr. Waite states, "I do want to see a standard agreed upon." Presumably he does not wish to imply that there is no standard (he must be familiar with B.S.S. 546 covering the round-pin type) but that it has not been generally accepted. He will be aware that the reason is that so many people have found the flat-pin type to give better service and to afford greater convenience from the point of view of interchangeability. Mr. Waite very fairly says that he has no preference for either type. Many people, including myself, have, however, and that being so, is there any valid reason why they should be debarred from using the type which they prefer? At present consumers cannot install flat-pin socket outlets without being made to feel that they are doing something reprehensible because the flat-pin type is excluded from the I.E.E. Wiring Regulations. In fact, in the areas of supply of some corporations which claim to have power to enforce their own regulations, consumers may even be refused a supply if they install socket outlets of this type. This is an intolerable position.

It is surely not necessary for the powers of Parliament, or for that matter of the Electricity Commissioners, to be invoked in order to impose upon consumers a type which they do not desire to use. A better solution is the one already suggested by the I.M.E.A., namely, to have a standard specification for both types and to aim at a more consistent adherence to the appropriate standards.

J. W. THOMAS.

Manchester, *October 10th.*

Consumers' Grouses

It is not easy to prove that common sense is one of the fundamentals of all the supply undertakings in this country. Both the consumer and the contractor have a strong case for a compulsory set of standard rules and conditions, uninfluenced and unrestricted by local prejudices. This should not represent a serious problem in these days of grid supply.

Manchester, *October 10th.* L. E. WILSON.

Mercury Switches

We notice in your issue of to-day's date that editorial comment uses the following expression: "Thus avoiding the use of fragile mercury tubes." Such a statement we consider misleading and unfair comment in view of the fact that mercury switches are no more fragile than the average electrical instrument.

Such a statement might have been true ten years ago, but to-day mercury switches are widely used in preference to open contacts by virtue of their life and freedom from maintenance.

MERCURY SWITCH MANUFACTURING CO., LTD.,

West Drayton, *October 7th.* JOHN SAWYER, *Manager.*

[We have had similar letters from the Drayton Regulator and Instrument Co., Ltd., and the British Thermostat Co., Ltd.—EDS., ELEC. REV.]

New Electrical Products

A review of equipment recently marketed

Remote Control of Street Lighting

In a system designed for switching on and off groups of lamps in limited sections from any point without the use of a continuous control cable which has been developed by the SORDOVISO MANUFACTURING CO., LTD., 220, The Vale, N.W.11, the main feature is the employment of cascaded control with a mercury relay that is unaffected by overloads.

In one application a master switch, which can be situated at any required point, operates a first relay, which immediately switches on the lamps in its group and energises the operating coil in the next group, which, in turn, switches on the corresponding lamps and so on indefinitely in succeeding sections.

Cascade switching can also be carried out with a definite delay between each operation, as shown in the accompanying diagram. The master switch operates the first relay, A, switching on lamps in group A and energising the Sordoviso delay unit, marked B1. This delay unit can have a time period of from half a second to five minutes, so that the second group is not switched on while the initial demand of group A is still high. After the specified interval has elapsed the delay switch B1 operates the contactor B2 which switches on the lamps in group B. As in the previous case, this operation can be carried on indefinitely, thus giving series control with a delay period between each operation.

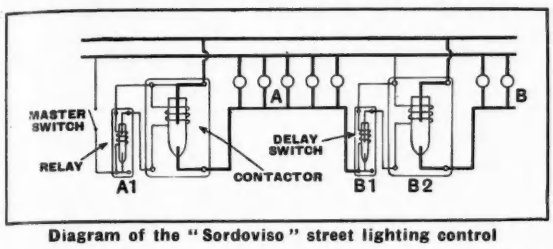


Diagram of the "Sordoviso" street lighting control

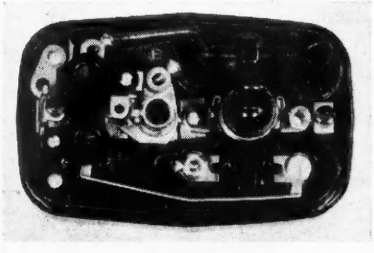
A single-phase supply is shown for simplicity, but in practice each successive group may be taken from a different phase.

A twin arrangement has been adopted by Bolton Corporation for an experimental length of street lighting. The twin unit can be supplied with one operating coil, so that two separate circuits are controlled in one operation or with two separate operating coils, giving either simultaneous or independent control of two circuits.

Several corporations are adopting twin units, so that should one side or section fail the other will remain in use. Triple units can also be arranged for various forms of control.

Developments in Switches and Plugs

In addition to the safety features provided in conformity with B.S.S.546 the latest switches of J. H. TUCKER & CO., LTD., King's Road, Tyseley, Birmingham, have a shuttered socket outlet and incorporate "Tamperproof" shutters to screen the live socket tubes. These shutters can only be displaced and contact made with the tubes by the correct insertion of all three plug pins simultaneously and the floating "Flexitube" contacts enable any make of B.S.S.546 plug of the appropriate rating to be used. The shutters—a one-piece moulding in Scarab non-tracking material—instantly close over the socket tubes, giving effective arc-suppression immediately the plug is withdrawn. The withdrawal of the plug actuates a safety catch which immovably locks the shutters over the tubes.



The Tucker "Tamperproof" switch-socket

A further development is the "Boxless" flush type with all live parts shrouded so that wooden boxes are not required in skirtings, panelling, or similar woodwork. The three-pin "Nolok" (non-interlocked) and "Stanlok" (interlocked) switched sockets are also redesigned to harmonise with the shuttered types. Insulated flush switch-plates now embody a specially designed reinforcement to counteract warping and a non-rotating one-section plate is introduced to ensure correct alignment. Another recent introduction is a 2-A design of the three-pin "Kwikwire" plug to B.S.S.546 with detachable non-rotating pins. Cable entry is of the protected type and shielded gripping flanges of adequate proportions facilitate withdrawal.

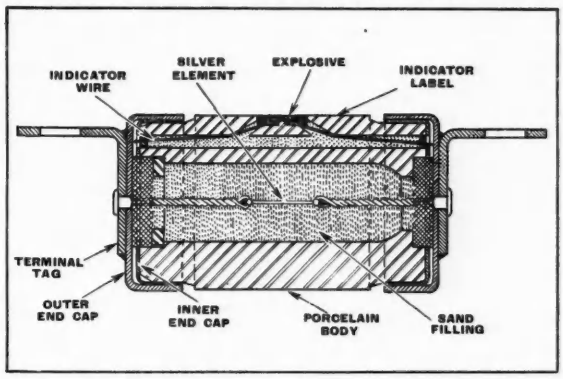
The new 7-A single-pole heater switch with all-metal frame and mica insulation is similar in design and construction to the "C.5000" 15-A type. A double-pole 15-A switch mechanism has been designed for mounting in circuit with washboiler elements to interrupt the supply immediately the boiler becomes dry. The increased temperature due to the total evaporation of the water actuates the mechanism and opens the circuit.

Attractive cellulose enamel to harmonise with white kitchen tiling is the new finish in which the AC shallow cooker control unit is now available. Minimum projection, short slow-break main and sub-circuit switches, shuttered socket outlets to B.S.S.546 and combined pilot and semaphore indicating arrangements make this unit well suited to AC circuits.

High-rupturing-capacity Fuses

A range of cartridge fuses with maximum ratings of 30, 60 and 100 A at 660-V and designed to clear three-phase faults up to 25,000 kVA and d.c. faults (single fuse) up to 16,000 kW has been standardised by the GENERAL ELECTRIC CO., LTD., Magnet House, Kingsway, London, W.C.2.

The enclosed fuse carrier and base, Home Office pattern, is of china and three types are available. One has terminals suitable for d.p. and t.p. switch-fuses and iron-clad cut-outs, another has bus-bar connections for use in distribution boards, and a third has back connection terminal stems for mounting on switchboards. They can be supplied with tag ends to be fitted into any other type of switch-fuse, &c. The cylindrical body of the cartridge is made of ceramic material and is closed by copper end caps carrying the terminals which are pressed direct on to the body without cement. Silver sand forms the arc-extinguishing medium.



A diagram of the new G.E.C. cartridge fuse

The fuse element consists of a straight-through silver wire reinforced at the ends by larger wires silver-soldered to it. Its resistance is thus lower than that of a plain element of the same rating with consequent reduction in heating. The centre portion melts first so that a comparatively small amount of resistance is then introduced into the circuit, increasing rapidly as the ends fuse. This allows a gradual reduction in current, thus avoiding voltage surges. When the fuse blows an indicator of fine-gauze wire melts, charring a paper label on the side of the cartridge.

In all except the lowest ratings there are two or more widely separated elements, increasing the surface area in contact with the filler and consequently the heat dissipation. The total section of the wire is therefore less and hence also the amount of metallic vapour to be deionised when the fuse blows.

Improved Intercommunication System

Because of induction and capacity effects in the interconnecting cables it is not always possible to guarantee simultaneous secrecy of conversation and full conference facilities over ordinary intercommunication telephones. The new "Mermaid" series of instruments announced by ALFRED GRAHAM & CO., LTD., Caxton House, Tothill Street, London, S.W.1, for marine and general office purposes do combine both these advantages, with others.

The "Mermaid" desk type telephone

Multi-way conversations can be carried on simultaneously with any number of available pairs of interlinking wires without cross-talk, while secrecy is maintained by relay-switching.

D

This involves the provision of one additional circuit wire only and is so arranged that only those instruments directly energised by the initiating caller become responsive. All others are deprived of positive voltage and so cannot be operated.

Any one instrument can assume "master" duties, which means that the originator of a two-way call can bring into the conversation other parties and also dismiss one or more of them without the possibility of surreptitious re-entry. Any one instrument in an installation can be given over-riding preference facilities, while a small pilot lamp indicates that a called instrument is engaged and not merely unattended.

Small Domestic Appliances

The "Samson" range of domestic appliances which is being marketed by ELECTRICAL COMMODITIES, LTD., Sparton Works, Beresford Avenue, Wembley, includes the "Trimatic" three-slice toaster, which toasts three slices of bread simultaneously. When finished, the toast is kept warm by an auxiliary heater which is automatically switched on. The "Auto-flip" toaster has an automatic turning action when each side is toasted. Thermostatic control is employed in the "Lifto-Lowboy" automatic waffle iron. A heat indicator shows when the grids are at a proper temperature for pouring batter. When the waffles are baked the thermostat cuts off the supply and as the cover is raised the waffle is lifted from the grids.

The "Visulator" coffee maker

The "Visulator" coffee percolator enables the coffee to be seen in the making as a special heat-resisting glass is employed; a larger edition is the "Coffeemaster," which also employs a special porcelain filter insert. In addition there are a four-heat boiling plate, a heating pad available in three forms, an ultra-violet sun lamp and an infra-red lamp.

Insulating Beads

The V.G. MANUFACTURING CO., LTD., Gorst Road, Park Royal, London, N.W.10, makers of the "Scruit" one-piece porcelain connectors, are now marketing a series of insulating beads.

These cup-shaped, interlocking, porcelain beads threaded over wiring give a high degree of insulation, yet allow complete flexibility for most intricate loops and bends. Impregnable to heat and damp, bead insulation protects wiring from damage, and is particularly suitable for electric fires or industrial plant where excessive heat is liable to break down the orthodox rubber or paper dielectric insulation.

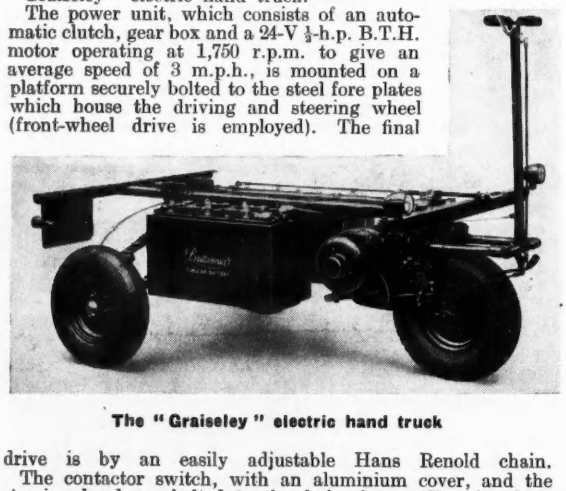
The following five sizes of bore are made (0.047 in., 0.070 in., 0.094 in., 0.118 in., 0.141 in.), suitable for SWG 19, 16, 14, 12 and 10, respectively. Terminal beads are also available for the larger sizes.

The beads are sold by the pound. A chart showing prices, sizes, and the number of beads per pound and per foot is available.

An Electric Hand Truck

DIAMOND MOTORS, LTD., Upper Villiers Street, Wolverhampton, has recently commenced the manufacture of the "Graiseley" electric hand truck.

The power unit, which consists of an automatic clutch, gear box and a 24-V ½-h.p. B.T.H. motor operating at 1,750 r.p.m. to give an average speed of 3 m.p.h., is mounted on a platform securely bolted to the steel fore plates which house the driving and steering wheel (front-wheel drive is employed). The final drive is by an easily adjustable Hans Renold chain.



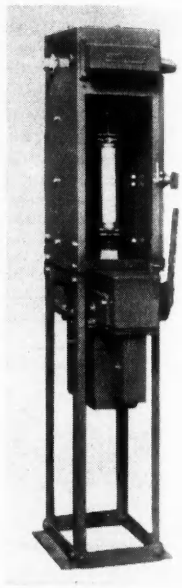
The "Graiseley" electric hand truck

The contactor switch, with an aluminium cover, and the steering head are bolted to the fork plates. The chassis is composed of straight weldless steel tubular members, the 24-V, 92-A Britannia battery being in two parts of 12 V each, one on each side of the frame.

Control of power is by a single lever fitted to the steering handle, and the control lever is connected by steel rods and roller joints to a heavy-duty contactor switch. A simple locking device prevents unauthorised use of the vehicle.

Single-phase Switch-fuses

A single-phase switch unit, incorporating a high-rupturing-capacity fuse, has recently been developed by SWITCHGEAR & COWANS, LTD., Old Trafford, Manchester. It comprises a quick make-and-break oil switch surmounted by a fabricated chamber housing fuses made by the English Electric Co., Ltd., of any rupturing capacity between 50,000 and 120,000 kVA. The unit is designed both mechanically and thermally for the maximum fault conditions, the switch having a strong and rapid "make" action to provide safe closing under such conditions. The mounting of the fuse can be easily adjusted to accommodate cartridges of various sizes.



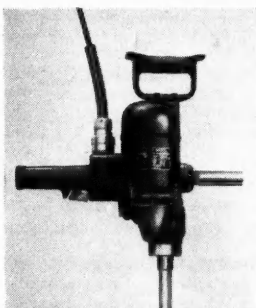
The S. & C. single-phase switch-fuse unit

The basis of the design of the switch fuse unit is the ability of the fuse to deal rapidly and effectively with short-circuit currents. This limits the current to be carried by the switch, and allows the design to be simplified, because the switch is not required, as some types are, to "make" on the peak value of the first current wave, or to carry short-circuit current for some appreciable time before arc interruption. A mechanical bolt, interlocked with the switch-operating handle, prevents access to the fuse chamber with the switch on.

A Portable Drill

An addition to the range of "Little Giant" portable electric tools manufactured by the CONSOLIDATED PNEUMATIC TOOL CO., LTD., 232, Dawes Road, London, S.W.6, is a heavy-duty machine (No. 595) for ½-in. drilling.

A high-torque salient-pole universal motor is used, for which a performance and commutation equal to that of a straight DC motor is claimed. The housing, of the flared type, directs the exhaust air away from the face of the operator, and has cowled inlet openings. Helical armature gears materially assist towards silent running. Ball bearings are fitted throughout, mounted in steel cast inserts and not direct into the aluminium housings. Through bolts are used for bolting together the housing, transfer plate and gear case, thus eliminating screws in tapped aluminium castings.

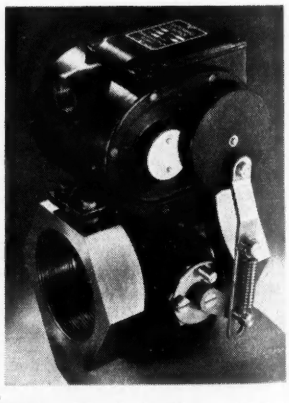


The "Little Giant" drill

Motorised Butterfly Valve

The latest development by the RHEOSTATIC CO., LTD., Slough, is a motorised butterfly valve which is designed to provide the heating engineer with a means of applying automatic temperature control to centrally heated buildings when used in conjuction with a thermostat.

An important feature is the design of the gland which employs neither packing nor bellows, being of all-metal construction. The valve sizes available are from 1¼ in. to 4 in. with screwed ends and from 3 in. to 6 in. with flanges, a type "PM" pulling motor being used. One application of this valve is for the control of dual water-heating installations, but it is suitable for many other applications where automatic control of the flow of liquids or gases is required.



The Rheostatic type "PMV" motorised butterfly valve

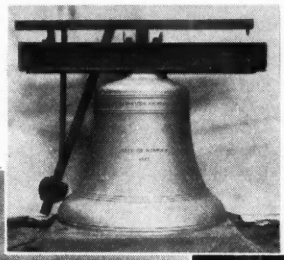
The high torque of the motor ensures positive operation and the valve takes 30 seconds to open and close, thereby preventing water hammer. The motor is energised only when opening or closing the valve.

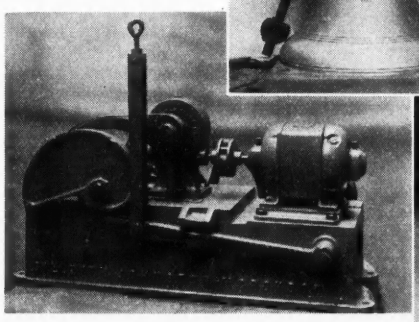
An Electric Tower Clock

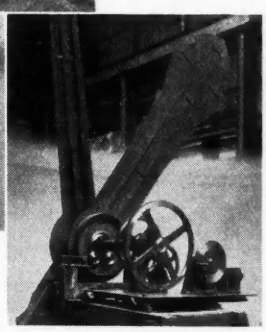
Unit-built design at Norwich

THE tower of the new Municipal Buildings at Norwich forms the setting for a large electric clock which has noteworthy features of technical design. It is operated by controlled frequency AC, indicating that "mains control" is now considered sufficiently well-developed to merit adoption for large administrative buildings. The installation is really made up of a number of distinct units, all entirely separate, and only linked by the AC, which supplies both motive power and timekeeping.

There are four 14-ft. dials of the chapter type, with the symbols indicating the hour divisions mounted directly on the brickwork of the tower walls. Each dial has its own separate movement, which is so compact that it can easily be mounted directly behind the dial centre, and partly recessed into the inner surface of the wall. The layout of these dial movements is particularly simple, a flat steel base-plate being mounted partly in the wall recess and partly on two small projecting girders for carrying the various components of the mechanism, and each component can be rapidly and easily removed and replaced if it should require individual attention.







Top: The hour bell, showing the hammer assembly. Left: The hour striking unit. Right: Dial unit, showing the synchronous motor drive, roller bearings and hand structure

The synchronous operating motors, one for each dial, are of the totally enclosed, permanent-magnet type, for 300 RPM at 50 cycles. The rotors are mounted on bronze spindles in ball bearings, and the "U"-shaped stators are mounted in box-type enclosing frames in a manner which permits of easy inspection and removal.

Flywheels on the rotor spindles provide a carry-over for momentary current interruptions, and also serve as starting knobs. The opposite ends of the spindles are directly attached through small resilient couplings to the worm spindles of the main reduction gears in oil-baths. A special arrangement of flanges on the hand spindles and recesses in the castings ensures that water which may penetrate past the hands at the dial centres is excluded from the movements, and simply drains off through holes at the base of the recesses in the castings. The external bearings of the hands, where the minute hand spindles revolve in the hour-hand tubes, are outside the tower walls and inaccessible for lubrication, but by the fitting of small copper tubes parallel to the hour hand tubes grease can be forced to the bearing points.

Hour striking without chimes is used for the audible indication of time. The hour-bell weighs 52 cwt., the diameter across its mouth is 66 in., and the striking hammer is pivoted above.

The motor-driven striking unit, close to the hammer itself, is controlled by a separate trip release switch operated by a synchronous motor of identical form to those used for the dial units. In addition to making the hourly contacts required by the striking release, the motor and its reduction gear also step a "barring-off" control which silences the striking at night. The actual lifting of the hammer lever is by a snail-cam driven through two stages of reduction gearing by a motor, and a count wheel of the pin type controls the switching of the motor circuit through a mercury switch of the tube form. This switch is tripped to the "on" position by an electro-magnetic release, and the unit then runs until the movement of the count-wheel causes a pin mounted on its rim to move the tube over and open the circuit.

The provision of entirely separate synchronous motor-driven units for each of the dials and for the control of the striking gear ensures that only the failure of the main current supply can cause a complete stoppage of the clock. The failure of any single motor or unit can only stop the particular section affected, and a hold-up of any one dial will leave the others and the striking of the hours unaffected. Each dial unit is cased in with woodwork, and glass panels in the case-doors permit the action to be inspected.

The yearly consumption of electricity of the five synchronous motors is about 300 kWh, and the cost of operation therefore compares very favourably with that of winding a mechanical clock. Gillett & Johnston, Ltd., of Croydon, constructed the clock, and the architects were James & Bywaters and Rowland Pierce.

Averages and Standard Deviations.

By G. W. Stubbings, B.Sc., A.M.I.E.E.

Their influence in meter testing

OF the three kinds of averages defined in books on statistics, the arithmetic mean is the most useful to engineers. The median is of limited significance, and, whilst the mode is often a representative figure which for certain purposes is of considerable importance, it is difficult to calculate accurately. Further the modal average is often ambiguous because a set of numerical data will sometimes give two or more modal values. The arithmetic mean is precise in its significance; it is that average with respect to which the sums of the positive and negative deviations are equal. Further the arithmetic mean is easy to calculate.

Each of these three statistical averages is a single number representative of a set of numerical data. The information which any one of them can give is necessarily limited, and there is a second kind of representative number which expresses the spread of the actual numbers of the set with respect to the average. The usual method of expressing the spread quantitatively is by a second kind of average number which is known as the standard deviation. This is the square root of the average of the squares of the deviations of the actual numbers from their arithmetical average. Standard deviation is usually denoted by the symbol σ. It corresponds roughly, in a mathematical sense, to the r.m.s. value of an alternating current.

The reason for averaging the squares of the deviations is usually stated to be that the process of squaring eliminates differences of the signs of the deviations to be averaged. The real reason is, perhaps, deeper seated than this. The standard deviation is a fundamental constant in mathematical statistical theory. From the practical point of view it would, of course, be possible to average deviations from the arithmetic mean by ignoring sign. The root-mean-square method is now the standard one, and it has the practical advantage of stressing the importance of the larger deviations.

The necessity for a second average value representative of deviation may be illustrated by considering the case of a number of off-circuit tests on meters of one particular type. The average of all the errors is certainly an important number, but the information it gives is really limited. A low average error may indicate a high standard of performance. Otherwise, there may be large plus errors which are balanced by large minus errors, or what is more likely, a number of relatively small plus errors which are offset by a smaller number of serious minus errors. The standard deviation of the set of test results answers to some extent by a single statement the question which the average error ignores. Indeed the two average values may be considered to be representative of two distinct characteristics of the meter type. The mean error gives an idea of the basic design, and the standard deviation of the excellence of manufacture.

The calculation of average and standard deviation values of a large mass of numerical data can be simplified by the application of some simple rules. In calculating average values, most people know the advantage of taking the mean of the deviations from a false average. Thus, in averaging a set of

The District Agency. By A. J. G. Smith

A discussion of the policy of exclusive dealer rights

IN the domestic market, the manufacturer who is seeking the most effective method of distribution of his products can occasionally learn something from the procedure adopted in the export field. In overseas trading, the majority of successful manufacturers wisely do not make any attempt to work a foreign market by their own staff or salesmen and travellers, nor do they try to control trading policy in that territory strictly from headquarters. The work of development of a country (or such portion of the country as forms a convenient trading unit) is handed over to a sole agent or distributor, who undertakes all the routine work connected with the sale of the products in question, and puts down an adequate stock to enable him to cope with the demand which he is engaged in creating.

Such a method could with advantage be applied to many industries for domestic trading, if we substitute for the territory covered a very much smaller district, such as a radius of five or ten miles from the distributor's place of business. The policy has been successfully adopted in many trades, and the backing it has received from influential manufacturers makes it worthy of full consideration in a trade such as ours.

Some Questions

The manufacturer has first of all to decide whether the appointment of a single agent or distributor in a certain district is likely to bring him more trade than the alternative policy of dealing with traders generally. The established manufacturer can readily ascertain what his past sales in the district have been, and if the prospective sole distributor is well introduced in the trade there should be really no undue difficulty for him to contract to take goods to a certain value per annum in return for the exclusive concession.

Even if the volume of trade thus produced is only equal to what the market has previously yielded under a policy of general trading, there are still certain advantages attached to the appointment of an exclusive agent. The latter would be a long-term arrangement; it would relieve the manufacturer of the bulk of his normal work of development in that area, and in the exclusive agent he would have someone permanently situated in the district attending to his interests and developing sales more or less on the same lines as a salaried representative. Travellers' journeys in that area would be almost entirely done away with, and user inquiries resulting from advertising could be referred to someone on the spot with the utmost confidence that these would not be used for pushing the sale of a rival and cheaper make, as is frequently the case where they are referred to an " unattached " trader.

The Distributor

The trader is in a somewhat similar position with regard to the questions he has to answer before coming to a decision whether it would be advisable for him to tie himself exclusively to a single maker, and relinquish (in this one particular line) his right to free trading. Will he be able to do a larger trade in handling a single well-advertised brand rather than dealing in all and sundry? In this connection, one point is fairly certain: if he turns over to one brand exclusively, the amount of stock he carries will in all probability be considerably reduced. He and his employés will become specialists in this particular brand rather than merely knowledgeable upon a number of makes, and this is a point which is of the greatest importance in successful selling as well as effective after-sale service where this may be required. Many traders may be effecting their greatest sales in one or possibly more brands, and yet have a larger capital invested in other slow-moving lines. The elimination of the latter can only be an advantage for the business.

If full success is to be achieved from the exclusive district agency, the whole of the implications of the policy require to be fully considered by both parties beforehand. A loose and ill-defined "gentlemen's agreement" resulting from general conversations under which one party believes he is committing himself to a certain course, while the other believes the arrangement to be much more comprehensive, will only produce trouble rather than turnover.

Nothing is lost by clear definition in such a case. In particular the agency should be *really* (and not merely *apparently*) exclusive on both sides. The area should be defined with precision, avoiding such loose terms as "shopping centre."

On the manufacturer's side also great attention has to be paid to the possibility of eliminating indirect competition. He may be prepared loyally to refer to his district agent all the inquiries coming from the latter's territory, but he has also to be prepared for the awkward situation which is often set up by a class of buyer who is perfectly content to make use of the local agent for demonstration and service facilities, but who when it comes to the point of placing orders prefers to pass these through some house with which there may be some personal connection, and possibly situated entirely out of the district to which the goods are to be supplied. Any agency arrangement should provide the district agent with the most complete cover against incidents such as this, which are more common than are generally supposed.

A Restricted Field

On the other hand, the agent must be prepared to relinquish entirely his freedom of choice in those goods covered by the agency, and he must not be tempted, even at a buyer's definite request, to quote for alternatives. Most of the troubles that arise out of such an arrangement are due to a human desire on the part of both parties to make the best out of all possible worlds.

A further important point concerns the duration of the arrangement. A district agency is not a matter for a few months, and unless the manufacturer is perfectly sure of the selling capabilities and the financial position of his prospective district agent, and the latter is equally convinced of the merits of the manufacturer's product to justify an arrangement for some two or three years, they would both be well advised to leave exclusive arrangements alone, and to rely entirely upon normal trading methods.

It will be seen that under a successful agency arrangement the mutual advantages are considerable. The manufacturer is able to economise upon many expenses of development work, and some of these savings should be legitimately utilised to assist the agent. The latter saves by reducing a too-varied and expensive stock; and some of the savings thus effected should be employed by supporting the manufacturer with really adequate stock orders. The greater the mutual commitments of both parties, the greater the possibilities of success.

While the trading policy outlined may not be adapted for staple lines, yet every industry has a certain number of specialities in the high-price field for which it is particularly suitable, and the fact that there are certain well-known makers who for more than a decade are still adhering firmly to this method of distribution is at least sufficient to show that it is worthy of consideration by well-established manufacturers and dealers alike.

Averages and Standard Deviations (*Continued from preceding page*)

numbers all of which were between 80 and 85, it would be quickest to average the deviations from a false average of 80, and then to correct the false average by the mean deviation. The false average can be taken so that some of the deviations are negative. The arithmetical work may then be simpler, but the chance of error is, perhaps, increased.

The false average method is also very useful in reckoning standard deviations. This short cut is, perhaps, not so well known. Here we calculate the average value of the squares of the deviations from the false average, and from this we deduct the square of the difference between the true and the false average. The difference is the square of the standard deviation. The truth of this rule can be shown by simple algebra for the case of the calculation of the standard deviation of a number of errors. Here the errors themselves are the deviations from the false average of zero. Let the errors be x_1 x^2 - -, etc. Then if the arithmetic mean error is x_0 the true deviations are (x_1-x_0), (x_2-x_0), and so on, and the sum of their squares is $(x_1-x_0)^2+(x_2-x_0)^2$, etc. This sum is equal to $\Sigma x^2+nx_0^2-2x_0$ $(x_1+x_2$ - - - -), where n is the actual number of test results, but $(x_1+x_2$ - - - -$)=nx_0$ so that the average of the terms $(x_1-x_0)^2$, $(x_2-x_0)^2$, etc., or $\sigma^2=(\Sigma x^2)$ $n-x_0^2$.

The arithmetic of this process can be illustrated by a simple numerical example.

Meter errors (x) Plus.	Minus.	x^2	
0.4		0.16	
	2.5	6.25	
	3.0	9.0	
	1.2	1.44	
1.0		1.0	
	1.0	1.0	
	1.5	2.25	
1.4	9.2	21.1	$=\Sigma x^2$
	1.4		
		3.14	mean x^2
	7.8/7 = mean, x_0	1.33	square of mean, x_0^2
	= 1.1	1.81	mean square of true deviations

$$\sqrt{(1.81)}=1.3=\sigma.$$

Business and Industrial Notes

Scottish Contractors' Conference. The New Warner Cinema. Wallasey and Medway Towns Exhibitions. Mercury Vapour Rectifier Improvements.

Britain Buys American Washing Machines

THE *Electrical World* reports that the marked increase in exports of household washing machines may be safely attributed to the United Kingdom, according to the electrical division of the Bureau of Foreign and Domestic Commerce. Although a consistently good customer for this appliance, Great Britain, during June, reached a peak for 1938 with purchases of 3,734 machines, valued at $131,090. At no time during this year have the purchases of any country been larger. The United Kingdom accounted for 47.7 per cent. by volume and 43.3 per cent. by value of the exports from the United States in June of 7,832 machines, valued at $302,660.

Cheaper Refrigerators Required

Speaking at the autumn dinner of the British Association of Refrigeration at the Park Lane Hotel on October 7th Sir Joseph Barcroft, chairman of the Food Investigation Board, said that he would like to see a refrigerator regarded as a necessity in every house. The average housewife, however, would not resort to that necessity so long as she had to pay the first costs and maintenance she was expected to to-day. A great service could be done if a refrigerator could be provided for her at less cost.

Scottish Contractors' Conference

A conference and luncheon held at Glasgow on October 6th under the auspices of the Electrical Contractors' Association of Scotland was attended by a company of 300. Representatives were present from the Electric Lamp Manufacturers' Association, Cable Makers' Association, Electrical Wholesalers' Federation, the Fair Trading Council, and supply authorities. The guests also included eighty electrical contractors who are not members of the Association. Mr. R. Kilpatrick, the president, presided at the luncheon, and said that while they appreciated the vast amount of good work which had been done between the various associations under the able leadership of their past secretary, Mr. W. Finlay, there was still greater work to be done in the future. Mr. W. J. Cooper, chairman of the Scottish Section of the Institution of Electrical Engineers, said that one of the important functions of the Association was, first of all, to attend properly to the market in which they bought, but he thought the time had come when they would have to give more consideration to some uniformity of practice in the market in which they sold. Dealing with the question of registration, he said that members of the Association should make this one of the planks in their policy. They ought to try registration out. Let them in a co-ordinated way make an application for registration so that they could ensure that only registered contractors could carry out responsible work. Mr. W. Riggs, president of the Electrical Contractors' Association, Inc., who also referred to registration, said that in England they were trying to go a step further and have registration made compulsory. That, so far as the English Association was concerned, was considered to be a vital point, and they thought it would cure a great many of the disabilities confronting them now. Mr. T. W. Heather, of the General Electric Co., Ltd., and member of the Fair Trading Council, speaking from the manufacturers' aspect, declared that they had tried to organise, though sometimes the reactions had not been what they expected. They were urged by the Government and other bodies to organise, and when they did so they were told that they had just formed themselves into a ring. It seemed a virtue on the one hand and a vice on the other. Organisation in any industry did not cut out competition. It substituted for the low type of competition of price alone something which was much more to the consumers' advantage, and that was quality and service. They should regard themselves as one industry, and whether they were contractors or distributors, manufacturers or supply authorities, they should look upon themselves as coming within that conception. The Fair Trading Council was an example of an honest and sincere attempt to organise, and out of chaos to make a clear path, so that they could all do their jobs in the best interests of the country at large.

The North London Exhibition

The North Metropolitan Electric Power Supply Co. and various manufacturers are providing a comprehensive display of the latest domestic electrical appliances at the North London Exhibition, which is being held at Alexandra Palace from October 12th to 29th.

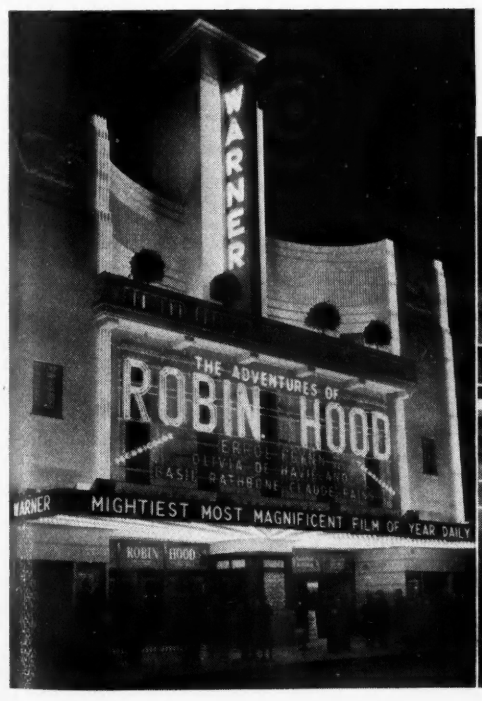
Institute of Hire-purchase

A meeting will be held on Monday next at Caxton Hall, Westminster, for the purpose of forming an Institute of Hire-purchase, a professional body devoted to promoting technical knowledge of hire-purchase and assisting the hire-purchase industry generally. All interested in hire-purchase matters are invited to attend.

The Warner Theatre

The provision of good acoustics has been the principal object in the design of the Warner Theatre, the new cinema which was opened on the site of the old Daly's Theatre, Leicester Square, on Wednesday. As a result the general layout of the auditorium is one of unusual simplicity, which in turn is reflected in the subdued illumination scheme. Two almost plain panels of light, one on each side of the auditorium, and six semi-indirect fittings shedding an amber light under the balcony are apparently the main sources of illumination, but actually much of the light comes from eighteen special dispersive type reflectors almost concealed from view in the false ceiling.

With a total load of 8 kW these inset fittings are arranged to give a soft light on the seats below, the walls and ceilings being illuminated by reflection only. Corbelux, Ltd., which supplied these special fittings, was also responsible for a scheme of concealed lighting in the entrance foyer, where long sweeping ceiling coves house ordinary 25-W lamps at 9 in.



The new Warner Theatre, Leicester Square, showing (left) the exterior at night and (right) the cafe lounge [*Elec. Rev. photos.*

centres with a remarkable freedom from "spotting." Four novel glass and spun-metal pendants, designed by the decorators, White Allom, Ltd., have been installed in the café lounge.

To compensate for the simplicity of the auditorium lighting, lavish use of illumination is made outside the building. In addition to fourteen "Ediswan" floodlights for the front elevation there are over six hundred 25-W lamps situated under the canopy, as well as a number of neon signs (Strand). A new type of screen (J. Frank Brockliss) used is made thinner in the centre than at the edges. Not only does this permit the sound to pass through more easily but it improves vision as it minimises spotting effect from the projector. Among other stage equipment are the three-colour lighting equipment (Strand) and a Compton organ, provided with an electric lift and turntable (Knight & Co.). The projection apparatus consists of three "Peerless Magnarc" projectors, two "Stelmar" spotlights and one biunial lantern, the necessary DC being supplied from two 20-kW Hewittic rectifiers, either of which will take the normal load. The resistances are of the unit type.

Rotary stabilising heads of a new type are to be found on the R.C.A. sound equipment, all the control apparatus for which, with the exception of a flush panel, is located in a special room adjoining. The same flush panel arrangement is to be found also for controlling the stage lighting, in this case a new type of all-metal panel made by Strand Electric being employed.

A Carrier plenum system of heating and ventilation has intakes at the top of the auditorium and extracts at the bottom and beneath the seats of the balcony. Provision is made for adding refrigeration equipment if found desirable. A central vacuum cleaning installation has been provided by the British Vacuum Cleaner & Engineering Co., Ltd., and there is a ten-line intercommunication telephone installation (Standard Telephones).

Unit construction has been adopted to good advantage by Drake & Gorham, Ltd., in designing the intake board, and high-rupturing-capacity fuses have been employed throughout to minimise delays in rectifying faults. Special supply arrangements are made for utilising the cinema for making films if required. Rather unusually the Chloride emergency lighting installation operates at the mains pressure of 230 V, thus obviating the necessity for keeping stocks of lower voltage lamps. The batteries, which are charged by means of Hewittic equipment, will take the full load for three hours. The electrical installation was carried out by Troughton & Young, Ltd., Charles H. Bell & Co., Ltd., being the consulting engineers for all the engineering services.

Vee-rope Drives

A table for ascertaining the value of vee-rope drives has been sent us by Ira Stephens, Ltd., Ashton-under-Lyne. The basis of this table is that the total pulley diameters are adopted, giving a large variety of shaft centres for each speed ratio. Worked examples facilitate calculations. The table is accompanied by a horse-power computer for the same type of drive.

Training Women Speakers

As a result of a special course organised by the Electrical Association for Women this week in London twelve further names will be added to the official list of speakers for the Association.

Works Visits

On September 22nd members of the Western Section of the Electrical Contractors' Association visited the telephone and radio works of the General Electric Co., Ltd., at Coventry. A party of about 120, including members from Bristol, Gloucester, Cheltenham, Cardiff and Newport districts, met at Stratford-on-Avon and proceeded to Coventry by special coaches. Arriving shortly after noon, they were welcomed by Mr. H. P. Wells, general manager of the Coventry works. After lunch the visitors were conducted around the works. They were shown many interesting aspects of manufacture and were particularly interested in the long assembly lines of radio receivers. The party reassembled for tea, after which there was a coach ride to Stratford-on-Avon.

At the conclusion of the Congress held by the Commercial Motor Users' Association at Birmingham a party visited the new Electricar factory at Hall Green.

New Showrooms at Broadstairs

In February, 1937, the Isle of Thanet Electric Supply Co., Ltd., opened showrooms in Margate and the success of these has led to the inauguration of further showrooms in Broadstairs. In addition to the ground floor showroom shown in the accompanying illustration, the basement has been fitted specially for the display of electric fires.

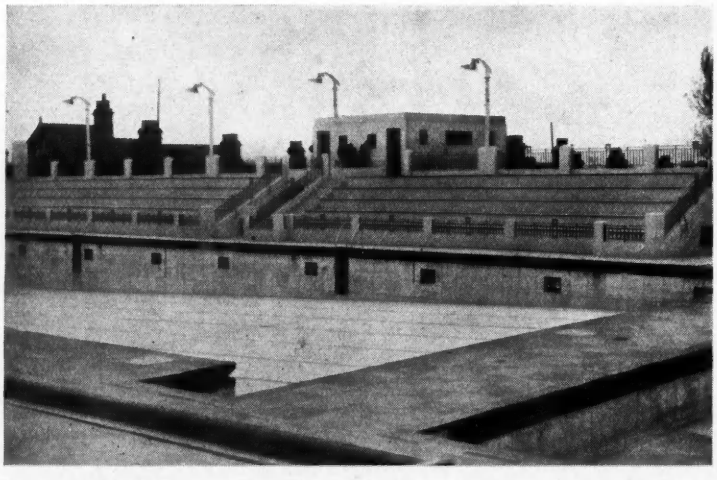
The new Broadstairs showrooms of the Isle of Thanet Electric Supply Co., Ltd.

Improvements in Mercury-vapour Rectifiers

At a gathering of electrical engineers at the technical service department of the Consolidated Edison Co. in New York, Prof. J. W. Dorsey, of the University of Manitoba, recently gave a demonstration of an improved mercury-vapour rectifying valve which he has devised. The new valve is a modified form of the standard "No. 866" valve and was shown to be capable of delivering a rectified output of 35 kW. During the tests the valve delivered 0.5 A peak at well above 70 kV before the grid system sparked over externally. On a six-phase basis this would be the equivalent of a 200-kW output. The low drop of 30-32 V in the valve is claimed to result in correspondingly low losses, while at the end of the tests the valve was not perceptibly warm, except round the heated cathode, even after several minutes of sustained operation. It is reported that a longer valve embodying additional grids to function up to 150,000 V is now to be constructed. The present valve, which is only about 16 in. long, was made by the United Electronics Co., Newark, New Jersey.

Bathing Pool Lighting at Ipswich

The Broom Hill bathing pool at Ipswich has recently been illuminated throughout by G.E.C. lighting equipment and "Osram" lamps. The underwater lighting is by means of twenty-four 250-W floodlighting units, and "Coolicon" reflectors are used for lighting the cubicles, G.E.C. conduit and fittings being used for the installation, which was carried out by Ipswich Corporation Electricity Department, under the direction of Mr. E. McLauchlan, the borough engineer and surveyor. A G.E.C. public address system also is installed.



The Broom Hill Baths, Ipswich, showing the G.E.C. underwater floodlighting installation

Wallasey Electrical Exhibition

Organised jointly by the Corporation Electricity Department, wholesalers of electrical appliances and electrical contractors, an electrical exhibition was held at Wallasey last week. Speaking at the opening ceremony, the Mayor of Wallasey (Ald. A. W. Vicary Scoins) said it had long been recognised that it would be unfair for the Corporation Electricity Department to compete actively with traders engaged in the electrical business. The exhibition, which was a combined effort in the demonstration of the various uses of electricity, proved that a good spirit prevailed between the Electricity Department and registered

contractors. Mr. B. T. Hawkins (borough electrical engineer) said that the exhibition was their first combined effort and there was no reason why it should not become an annual event. Exhibits included various domestic electrical appliances and a dish-washing machine suitable for hotels and restaurants. One section was devoted to a display of sodium street lighting and ultra-violet ray apparatus for testing materials.

Our Annual Domestic Number

Although we made reference in our last issue to certain products of J. H. Tucker & Co., Ltd., their name was inadvertently omitted from our index to manufacturers. Their address is King's Road, Tyseley, Birmingham.

In referring to the "Toastmaster" in our last issue we incorrectly ascribed this to A. C. Gilbert & Co. The "Toastmaster" is a registered trade mark of the McGraw Electric Co., for which Frank V. Magrini, Ltd., inform us they are the sole distributors in Europe.

Turkish Customs Tariff Reductions

The *Board of Trade Journal* contains a list of goods imported into Turkey on which reductions have been made in the import duties. From this we have selected the following electrical items :—

	Rate of Duty.	
	Former.	New.
	£T per 100 kg.	
Miners' lamps, electrically operated	60	6
Miners' lamps of copper electrically operated... ...	262.5	26.25
Voltmeters and electricity meters with clockwork, for use in factories	0.4	0.04
Electric motors, dynamos, transformers, commutators, resistances, coils, ventilators, vacuum cleaners and similar articles :—		
Up to 10 kg. exclusive	40	4
From 10 to 50 kg. exclusive	12.5	1.25
,, 50 to 1,000 kg. exclusive	7.5	0.75
,, 1,000 to 2,000 kg. exclusive	6.5	0.65
,, 2,000 to 5,000 kg. exclusive	5	0.50
5,000 kg. and more	4	0.40

Public Health Exhibition

Heating and ventilating apparatus, and canteen and food preparation equipment will figure prominently at the Public Health Services Engineering and Equipment Exhibition and Congress, which is to be held from November 14th to 19th at the Royal Agricultural Hall, Islington. Special sections will deal with air raid precautions.

Prices of Materials

Henry Gardner & Co., Ltd., report, October 12th : Copper bars (best selected), sheet and rod, £82, £2 increase. English pig lead, £18, 15s. increase. Spelter, £14 17s. 6d., 15s. increase. English block tin, £206 10s., £10 5s. increase. Mercury, £14, 10s. increase.

Frederick Smith & Co. report, October 12th : Electrolytic copper bars, £51 10s., £3 increase. Ditto, ditto, wire rods, £56 5s., £3 increase. Ditto, ditto, h.c. wire, 8$\frac{5}{16}$d., $\frac{3}{4}$d. increase. Silicium bronze wire, 9$\frac{1}{4}$d., $\frac{3}{4}$d. increase.

Edward Till & Co. report, October 12th : India rubber, Para fine, 8d., $\frac{1}{4}$d. increase.

Medway Towns Exhibition

What is stated to have been the largest exhibition of its kind ever held in Kent was opened at Gillingham on September 28th, the ceremony being performed by Admiral Sir E. R. G. Evans. It was originally intended that the exhibition should close on October 8th, but owing to its success and to the fact that its opening days were overshadowed by the international situation, it was decided to postpone the closing date until October 15th. The electrical industry was well represented, not only by the local electricity undertaking, but also by many traders from the towns of Chatham, Gillingham and Rochester, and manufacturers of electrical appliances. In addition, radio sets and accessories and electrically operated equipment were shown on many stands belonging properly to trades outside the industry. The exhibit of the Gillingham Corporation Electricity Department occupied eight stands, on which were displayed and demonstrated a wide range of electrical appliances, including Sadia water-heaters, Moffat cookers, Belling fires and cookers, Pyramid utensils, and Revo and Creda cookers. A new range of Berry's imitation coal fires was shown for the first time in the district. Demonstrations of cooking by electricity were given on the stand and also in a special demonstration hall by Moffat, Revo, Belling and Creda experts. Electrical appliances were also shown on the stands of the following concerns : A. F. Smith & Sons, Ltd.; Moffats, Ltd.; Tellus Vacuum Cleaners, Ltd.; British Vacuum Cleaner and Engineering Co., Ltd.; Wilkins & Mitchell; Alexander Rawlinson Mfg. Co., Ltd.; Burco, Ltd.; Hurley Machine Co., Ltd.; Beatty Bros., Ltd.; Ideal Home Electric Appliances, Ltd. and Rowland Rees Health Appliance Co. The chairman of the exhibition was the Mayor of Gillingham (Councillor Leatham J. Newnham).

On-load Tap Changing

With reference to the article bearing the above title which appeared in our issue of September 30th, the photograph at the top of page 446 related to 55,000-kVA banks of transformers as stated in the text. The on-load tap-changing gear for 66-kV service illustrated is fitted to the 40,000-kVA transformer mentioned in the main body of the article and is intended to provide only one example of the particular equipment which is tested at 133 kV.

Trade Announcements

British Mechanical Productions, Ltd., has acquired the "Safeways" business from Philip Knowles, Ltd., and is taking over the manufacture and marketing of the complete range. The transfer came into effect on September 1st, 1938.

Mr. W. T. Driver, manufacturer of the "Empire" electric trouser presser and the "Driver" heating attachment for electric fans, has removed to larger premises at 36, North Road, Holloway, N.7 (telephone : North 3205).

Appointments Vacant

Chief assistant engineer for Leeds Electricity Department.

Electrical and mechanical engineer for the Government of Jodhpur, Rajputana, India.

Senior demonstrator and junior assistant for Taunton Electricity Department.

Electrical and heating engineer in the Office of Public Works, Dublin.

Maintenance engineer for the China Light & Power Co., Ltd.

Two shift engineers for the Central Argentine Railway, Ltd.

Technical assistant in the Meter Department of the London and Home Counties J.E.A.

Civilian mechanist (electrical) in the War Department.

Assistant distribution engineer for the Hongkong Electric Co.

Sub-station attendants, meter fixer and meter reader for Hammersmith Electricity Department.

Deputy chief engineer for the West Midlands J.E.A.

Chief showroom assistant for Bolton Electricity Department.

Draughtsman for Dover Electricity Department.

Cookery demonstrator for Gloucester Electricity Department.

(See our classified advertisements.)

New Catalogues and Lists

British Insulated Cables, Ltd., Prescot.—Leaflets dealing with frames and covers, disconnecting network boxes, service cut-outs, and iron-clad service cut-outs.

British Thermostat Co., Ltd., Windmill Road, Sunbury-on-Thames.—A leaflet dealing with a pressure-operated water valve and strainers and dryers for refrigeration systems.

Automatic Coil Winder & Electrical Equipment Co., Ltd., Winder House, Douglas Street, London, S.W.1.—A leaflet dealing with the company's measuring instruments.

Cooper & Smith, 94, Charlotte Street, London, W.1.—Details of "Hely" wall bracket fittings and candle fittings.

J. H. Tucker & Co., Ltd., King's Road, Tyseley, Birmingham. —A 100-page illustrated catalogue of switchgear and accessories for domestic purposes.

The British Rototherm Co., Ltd., Station Road, Merton Abbey, S.W.19, has issued a brochure entitled "Modern Thermometry," in which the advantages of the bi-metallic temperature gauge and various applications are set out in addition to the usual catalogue features.

Air Conditioning & Engineering, Ltd., 123d, Victoria Street, London, S.W.1.—Details of the "Zephaire" air conditioner.

Drake & Gorham Wholesale, Ltd., 77, Long Acre, London, W.C.2.—Catalogues of electric lamps, and of electric fires, radiators, water heaters and domestic appliances.

Typerlite Co., 86, Cannon Street, London, E.C.4.—Leaflets showing the adaptability of the "Typerlite" table standard.

Renold & Coventry Chain Co., Ltd., Didsbury, Manchester. —A brochure showing the application of Renold chains for driving and carrying in the brewing and bottling trades.

Bankruptcy Proceedings

J. J. Eastick & Sons (a firm), wireless factors, 118, Bunhill Row, E.C., and branches.—The public examination of the partners in this firm was held on October 4th at London Bankruptcy Court before Mr. Registrar Stiebel. The statement of affairs lodged showed gross liabilities in respect of the joint estate of £72,229, of which £62,526 was expected to rank for dividend, against available assets of £18,643. The two debtors under examination were Mr. J. C. N. Eastick and Mr. L. E. K. Eastick. The former, in evidence, said that the business of analytical chemists and manufacturers of portable electric lamps, &c., was commenced in 1909. Since 1921 the business had been extended to that of manufacturers of wireless components and electrical and radio factors. Consequent upon the expansion of the wireless trade the business was removed in 1925 to Bunhill Row. Subsequently nine branches in various parts of the country were opened, conducting wholesale wireless and electrical business which involved giving a great deal of credit to small shopkeepers. Additional finance for the business had been obtained from time to time by bank overdrafts and loans. The turnover had been affected adversely since 1936 by a change in the policy of certain manufacturers and also since 1937 by the decrease generally of the volume of trade in the wireless industry. Since March last attempts had been made to effect an arrangement with the creditors and in pursuance of that idea a private limited company, J. J. Eastick & Sons, Ltd., was incorporated in May last with the object of acquiring the business, but that company had not functioned. Mr. Eastick attributed the failure to the general decline in the radio industry, price-cutting by competitors, bad debts, obsolescence of stock, to his personal loss on the Stock Exchange and to loss of turnover through change of policy by manufacturers. He said that up to June, 1937, trading profits were earned. Accounts for the period to July 22nd last showed that there was a turnover of £153,219 but there was a net loss of £9,914. The separate estate of Mr. J. C. N. Eastick showed ranking liabilities of £10,518 and assets estimated to produce

£290. The separate estate of Mr. L. E. K. Eastick showed liabilities of £111 and assets valued at £7. The examination was concluded.

W. H. Axworthy, John Lane, Cobourg Street, Plymouth, lately carrying on business at New Town Chambers, Old Town Street, Plymouth, and previously at 106, Tavistock Road, Plymouth, electrical contractor.—The public examination of this debtor took place recently at the Western Law Courts, Guildhall, Plymouth, when it was stated that there were liabilities of £700. Debtor said he commenced business in 1922 with a capital of £80, and between 1927 and 1934 the business was very successful. He then started dealing in radio sets on hire-purchase terms, but sustained losses through customers defaulting. In 1936 when his liabilities were £2,639 he executed a deed of assignment, and a dividend of 6d. in the £ was paid. Afterwards he recommenced trading with borrowed money, but was not successful. At Christmas last year he closed the shop at Tavistock Road as he could not obtain supplies. The examination was concluded.

J. H. Thompson, carrying on business alone as C. M. Hawkins & Son, 186, Lodge Lane, Liverpool, electrical contractor.—The adjourned public examination was held recently at the Court House, Government Buildings, Victoria Street, Liverpool. It was stated that the liabilities amounted to £579, and there was a deficiency of £521. Debtor attributed his failure to taking over an insolvent business, decreased turnover, customers defaulting under hire-purchase agreements, and heavy costs of suing and judgment creditors. The examination was closed.

L. W. Squirrell, radio dealer, Langstoft, Baron Estate, Berechurch Road, Colchester, lately carrying on business at 372, Woodbridge Road, Ipswich.—Receiving order made September 29th on debtor's own petition.

A. G. Field, radio dealer, 27, Station Road, Chadwell Heath, and 22, Rowallan Parade, Dagenham, Essex.—Public examination November 2nd at the Shire Hall, Chelmsford.

M. R. Horne (Malcolm & Stewart), radio and electrical retailer, 491, Alum Rock Road, Birmingham.—Receiving order made October 3rd on debtor's own petition.

J. W. Harrison, radio engineer, 29, Midland Street, Hull.—Receiving order made October 4th on debtor's own petition.

T. J. Mathews, 40, Rumbridge Street, Totton, formerly carrying on business at 105, High Street, Shirley, Southampton, 66a, St. Mary's Road, Southampton, and 4, Bridge Street, Winchester, under the style of Universal Radio, radio dealer.—Date fixed for proceeding with examination October 19th at the Court House, Southampton.

F. W. Hirst, radio dealer, 1, Newlands Buildings, Marton Road, Middlesbrough.—Last day for receiving proofs for dividend October 27th. Trustee, Mr. C. L. Townsend, 80, High Street, Stockton-on-Tees, Official Receiver.

Company Liquidations

Whitehead Switchgear, Ltd.—In consequence of the absorption of the company by Whitehead Switchgear & Inventions, Ltd. (registered and incorporated on May 12th, 1938), Whitehead Switchgear, Ltd., is being wound up voluntarily. The liquidator is Mr. E. Holbrook, 24-25, Western Mail Chambers, Cardiff. This is a members' voluntary winding-up and all the debts of the company have been, or will be, paid in full. Particulars of claims to the liquidator by October 28th.

Autocar Electrical Co., Ltd.—Winding up voluntarily. Liquidator, Mr. E. B. Wake, 184-196, West Street, Sheffield. Particulars of claims to the liquidator by October 21st.

Trade Mark Applications

The following are among the recent applications for British trade marks. Objections against any of the proposed marks may be entered within one month from October 5th:—

Z (lettering and design). No. 581331. Class 8 (III). Philosophical and scientific instruments and apparatus for useful purposes.—Ceskoslovenska Jovka A.S., Brno, Brunn, Czechoslovakia. (British representatives: Reddie & Grose, 6, Bream's Buildings, Chancery Lane, W.C.2.)

Little Briton. No. 585913. Class 13 (III). Electric switches (ordinary), electric switches (ordinary) combined with plug and socket couplings, plug and socket couplings, switch cover plates, boxes and bases, and bell pushes, all of ordinary metal.—C. H. Parsons, Ltd., Britannia Works, Wharfdale Road, Tyseley, Birmingham.

Jackson. No. 58066. Class 18 (III). Self-feeding electric and gas water heaters.—Jackson Boilers, Ltd., Vulcan Works, Shafton Lane, Holbeck, Leeds.

Pulsowash. No. 586136. Class 18 (III). Washing boilers.—Siemens Electric Lamps and Supplies, Ltd., Caxton House, Tothill Street, Westminster, S.W.1.

Rustil. No. 600621. Class 11 (IV). Electric lamps, not for surgical purposes.—R. S. Guthrie, trading as J. Russell & Co., 4, Castle Street, Edinburgh.

Information Department

GENERAL inquiries from readers relating to sources of electrical goods, makers' addresses, &c., are replied to by our Information Department through the post. Inquiries should be accompanied by a stamped addressed envelope.

Our extensive records enable us to reply to most queries, but occasionally we ask for our readers' assistance in tracing names and addresses not known to us. We should be glad to have such information regarding the following:—

MACKINTOSH acid-proof well-glass fittings.
BETTER LIGHT lamp, agent for.
THALE or THALD lampholder.
Floor polisher with polish feeding attachment.
CLIPITE clip for bedlight.

The Dairy and Ice Cream Show

ACTUALLY the most outstanding development at the National Dairy and Ice Cream Show now being held at Olympia, London, is not strictly either dairy or ice cream plant. Though closely related in construction to the ice-cream conservator, the new frosted food cabinets have, to judge from their enthusiastic reception in the United States, a much wider field of application. They enable practically every kind of perishable foodstuff to be marketed all the year round at very low cost and meat, fish, fruit and vegetables frozen and distributed in refrigerated vans to the cabinets are said to be almost indistinguishable from fresh when thawed out. All the exhibitors of the cabinets, among whom were the International Refrigerator Co. (Russ equipment), the Pressed Steel Co., and the Smithfield Refrigerator Co. (in conjunction with York Shipley), predict a big future for them.

Among the other new apparatus shown, ice-cream equipment monopolises most of the attention. Improvements centring mainly on appearance, rounded corners and the elimination of all projections are features of new "Prestcold" and International Refrigerator Co.'s freezers and conservators; the latter make incorporates new easy-clean, scraper blades. Any temperature can be obtained in any of the five compartments of a new Lightfoot freezer-conservator, which can be supplied with a Westinghouse hermetically sealed unit if desired. Another new Lightfoot product is a circular storer with three compartments.

To represent a new range of cabinet type continuous freezers British Automatic Refrigerators (1936) show an 8-gal. model. A new streamlined Russ continuous freezer capable of delivering 2 gal. in six minutes, is driven by a 1½-h.p. motor and is entirely automatic. It is marketed by the International Refrigerator Co., which is also demonstrating a new type of insert tank. A combined 30-gal. an hour freezer and tank for twenty-four sets of inserts appears on the "Prestcold" stand.

Other improvements in ice-cream and milk-bar equipment are to be seen on the stands of York Shipley, L. Sterne & Co., Cherry-Burrell, Frigidaire, Kelvinator and Flugel & Co. (London). A mobile milk bar is shown by A. H. Smith. Demonstrations of the "Neopak" ice-cream cup making and filling machine are given by Rappings, Ltd., while Nathan's Sales show how "choc-ices" are made.

The use of ultra-violet rays for sterilising purposes is a new application of Hanovia plant employed by R. Powley & Sons in their "Ster-Ray" bottle-cleansing equipment. Approximately 6,000 bottles can be treated for a consumption of 1 kWh of electricity. The mechanical fastening of paper caps over milk bottles with gummed tape is a feature of the Fords (Finsbury) stand, and G. S. Clayton have, in addition to a display of "Quicka" bottle washers, a new version of the "Swift" filling and capping machine.

Homogenisers are much in demand these days for producing process creams, &c., and we noticed models made by Gunnar Hartmann, Hiron & Rempler, G. C. Hurrell & Co., and Brush. For the production of ice-cream mixes, &c., the Joe Lowe Food Products Co. have "Jo-Lo" emulsifiers available delivering from 3 to 300 gal. an hour. Electrically operated butter-moulding and weighing machines are obtainable from G. Llewellin & Son. In addition to individual manufacturers' displays there is a special model dairy, which has been largely equipped with electrical plant.

A good array of electric vehicles for delivery purposes includes models manufactured by Murphy Cars and Trucks, Partridge Wilson & Co., Victor Electric Vehicles and the Associated Electric Vehicle Manufacturers, Ltd. Among the display of Electricar and Morrison Electric products shown by the last-mentioned concern is one of the larger range of vehicles, a 50-cwt. Electricar model with an 8-ft. 9-in. wheelbase, a 5-ft. wheel track and a 13-ft. 1½-in. body space.

The exhibition closes this evening (Friday).

Power Factor Correction

AN endeavour to explain, very briefly, the general principles of power factor correction in a way that can be understood by the non-technical is made in a 16-page illustrated brochure issued by the Wego Condenser Co., Ltd., Bideford Avenue, Perivale, Middlesex. Nine diagrams of connections show how individual and group connection can be applied to different circuits, while a quadrant diagram, tabulated data and formulæ are included for calculating the appropriate condenser capacity. Examples of savings to be effected by correction in this manner are given, together with constructional features of the company's condensers.

Electricity Supply

Lighting, Domestic, Power

Aberdeen.—ELECTRIC LIGHTING RECOMMENDED.—The Watching, Lighting and Fires Committee of the Town Council recommends that for the lighting of the Kaimhill housing estate electricity should be used. The cost is estimated at £1,412.

Adwick.—DISCHARGE LIGHTING SCHEME.—The Council has approved a recommendation of the Electricity Committee that it should proceed with the first section of a scheme for lighting the Great North Road, between Woodlands and Highfields, with electric-discharge lamps.

Alford.—LIGHTING INAUGURATED.—An electric street lighting scheme has been inaugurated by the Grampian Electricity Supply Co. at Alford, on Donside. A large company assembled at the switching on, including Messrs. M. G. Johnston and W. Melville, representing the Grampian Co., and Mr. A. B. Robertson, the electrical contractor.

Aysgarth.—RURAL SUPPLIES.—The Rural District Council has received a letter from the Electricity Commissioners stating that, from details submitted by the Hawes Electric Lighting Co., Ltd., there does not appear to be reasonable grounds for providing a supply to villages in Upper Wensleydale, but promising to communicate with the company again if the demand increases. The Council has replied that it is not satisfied as to the figures of income from the various villages, and that further information will be obtained.

Barnsley.—ELECTRIC WASH-BOILERS.—The Housing Committee has accepted the estimate of the electrical engineer for the installation of an electric wash-boiler in each of the flats over the shops on the Mount Vernon estate.

Barrow.—DISTRIBUTION PLANS.—On a recommendation of the borough electrical engineer it is proposed during the next five years to change-over the supply to AC in the part of the town lying on the north-east side of the railway, together with Walney Island and Barrow Island. For this purpose new equipment is to be installed in a number of sub-stations and AC feeders laid between such sub-stations during the winter. The engineer is to submit estimates of the cost of the works involved to the next meeting. Mains are to be extended to houses at Hawcoat at a cost of £5,500 and on the Matlock estate (£361). The provision of a supply to Grizebeck will cost £791.

Birkenhead.—INSTITUTION HEATING.—The Assistance Committee has requested the gas and electrical engineers to submit schemes for additional heating at the Institution.

Bradford.—ELECTRICITY ON FARMS.—The Health Committee is to install electricity in farm buildings at Westwood at a cost of £142.

SUB-STATION CONSTRUCTION.—The Electricity Committee is to provide a sub-station in Station Road, Manningham, and modify equipment at the premises of J. F. Raspin, Ltd., for the company's own supply, at a cost of £7,159.

OVERHEAD LINES.—The Electricity Committee is seeking sanction to borrow £10,000 for overhead distribution lines.

Bristol.—PORTISHEAD POWER STATION EXTENSION.—The Electricity Committee has been directed by the Central Electricity Board to install an additional steam raising boiler at the Portishead generating station. Together with the associated electrical auxiliaries and an extension to the boiler house buildings the total estimated cost is £106,384. The Board desires this plant to be in commercial operation by September, 1940.

Broughton.—STREET LIGHTING.—The North Lincolnshire and Howdenshire Electricity Co. has secured the contract for the lighting of the streets, in competition with Brigg U.D.C. gas undertaking.

Bury.—SUPPLY PROGRESS.—In his report for the past year Mr. J. G. Potts, engineer and manager of the Electricity Department, attributes the increase in domestic consumption largely to the new showrooms in Market Street, where demonstrations, special displays, advertising and advice have done much to familiarise the public with the various uses of electricity. Total sales of energy increased during the year by nearly 10 per cent. to 39.4 million kWh, which included 6.6 million kWh (12 per cent. increase) supplied in bulk to the Heywood undertaking. The number of consumers rose by 1,008 to 14,054. Although charges were reduced last year in the face of rising costs, the Department made a net profit of £15,822.

Cardiff.—ACCELERATED DOMESTIC DEVELOPMENT.—In reviewing the growth of the undertaking during the past year Mr. E. Jones, the city electrical engineer and manager, draws attention to the increased adoption of the "all-in" domestic tariff, 2,253 consumers having changed from the flat rates during the year. It is also noted that the "all-in" prepayment meter is greatly appreciated by weekly wage earners. Simultaneously, there was a much greater demand for electric cookers, the net increase of 2,077 comparing with 842 in the previous year. All classes of supply except traction contributed to the total expansion, the proportionate advances being as follows: lighting, 5 per cent.; heating, cooking, &c., 9 per cent.; "all-in" domestic, 30 per cent.; power, 14 per cent., and public lighting, 7 per cent. Altogether sales improved by 12 per cent. to 131.5 million kWh, for which the average price obtained was 0.78d., excluding meter rents, &c. At March 31st the total number of consumers was 57,002, the increase of 3,002 comparing with 2,765 in the previous year. The financial result of the year's trading was a net surplus of £56,044, but heavy expenditure out of revenue on new cookers, meters, offices and showrooms, and other items of a capital nature, together with a contribution to the rates of £14,626, resulted in the revenue balance being reduced from £146,754 to £131,866. During the past seventeen years £333,719 has been allocated in aid of the rates.

Cleethorpes.—ABOLITION OF METER RENTS.—As from October 1st, the Electricity Department has abolished meter rents.

Colchester.—FRINGE ORDER.—The Electricity Committee is seeking a Fringe Order to supply premises at Goldhanger.

AIR RAID PRECAUTIONS.—The Electricity Committee is undertaking air raid precautions at a cost of £1,445.

LOW-VOLTAGE DISTRIBUTION.—Subject to consent of the Ministry of Transport to the erection of overhead lines, the Town Council proposes to provide low-voltage distribution in a number of districts. An AC service cable is to be laid to the North railway station of the L.N.E.R. for use in connection with the installation of new equipment. The existing DC supply is to remain unaltered. An overhead line is to be run to the proposed new Cooks Mill Water supply borehole and the necessary sub-station and equipment afforded.

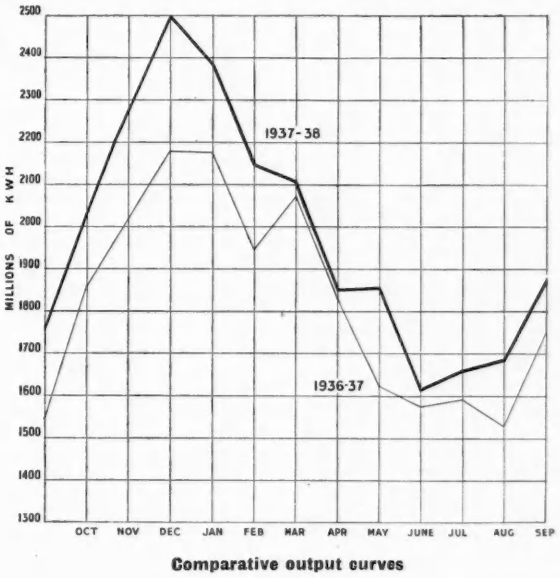
OPERATION OF POWER STATION.—The Council has received intimation from the Central Electricity Board that it is necessary for the Hythe generating station to be put into commission as soon as possible as an emergency measure and approving the immediate purchase of 2,400 tons of coal for this purpose.

Culross.—SUPPLY SCHEME.—Plans have been prepared for the erection of a sub-station by the Fife Power Co., Ltd., and arrangements have been completed for the wiring of houses and business premises.

Dorking.—J.E.A.'s FINANCES.—It was resolved at a recent meeting of the Council to request the Electricity Commissioners "further to consider the possibility of extending the periods of such of the loans of the London and Home Counties Joint Electricity Authority as may be found advisable in order that the 10 per cent. increase in charges may not be necessary." When the matter was debated Mr. Wilkinson said that his position as a member of the J.E.A. made it difficult for him to say anything in open Council. His attitude, however, was that a considerable saving in costs could be effected. Referring to the £20,000 put down as additional costs due to increased rates and superannuation in the report of the chairman of the J.E.A., Major Chance said that Dorking and other local authorities, through no fault of their own, had made an excessive

Generation of Electricity in September

OFFICIAL returns rendered to the Electricity Commissioners show that 1,872 million kWh was generated by authorised undertakings in Great Britain during the month of September, as compared with the revised figure of 1,752 million kWh in the corresponding month of 1937, representing an increase of 120 million kWh, or 6.8 per cent. The number of working days in the month (*i.e.*, excluding Sundays) was twenty-six, the same as last year.



Comparative output curves

During the nine months of 1938 up to the end of September the total amount of electricity generated by authorised undertakings was 17,160 million kWh, as compared with the revised figure of 16,092 million kWh for the corresponding period of 1937, representing an increase of 1,068 million kWh, or 6.6 per cent.

rate on the properties of the J.E.A., and there would have to be refunds. Also, the Authority's rates would be lower on the new assessments.

Dumfries.—LOANS.—At its last meeting the Council agreed to apply to the Electricity Commissioners for permission to borrow £10,000 for mains and services and £3,000 for the purchase of meters.

Eccles.—MAINS.—The Electricity Committee is applying for permission to borrow £20,000 for mains.

AIR RAID PRECAUTIONS.—An expenditure of £5,300 on a scheme of air raid precautions has been approved by the Electricity Committee.

SUPPLY TO NEW HOUSES.—A supply is to be provided to eighteen houses in course of erection in School Street, Winton, at a cost of £200.

Gateshead.—SUB-STATION.—The erection of a sub-station at Queensway, on the Team Valley Estate, is proposed by the North-Eastern Trading Estates, Ltd.

Folkestone.—ELECTRICITY FOR COUNCIL HOUSES.—The Town Council has agreed to terms suggested by the Folkestone Electricity Supply Co., Ltd., for the supply of electricity to proposed houses at Shaftesbury Avenue. The company will bear the cost of the cable in the roadways, the Council paying for the service cable from the road to the overhead line.

Gravesend.—NEW MAIN.—The Electricity Committee is to lay a new main from the Tollgate to Cross Lane, at an estimated cost of £1,550.

Haswell (Co. Durham).—STREET LIGHTING.—The Parish Council is recommended to accept revised terms by the South Hetton Coal Co., Ltd., for electric street lighting at South Hetton. It was originally proposed that the North-Eastern Electric Supply Co. should take over the network and supply the area, but the company stated that this would take considerable time.

Hebburn-on-Tyne.—LIGHTING AGREEMENT.—The Urban District Council has decided to enter into a ten years' street lighting agreement with the North-Eastern E.S. Co.

Hull.—METERS.—The Electricity Committee is seeking sanction to borrow £15,000 for meters.

Keighley.—AIR RAID PRECAUTIONS.—The Electricity Committee is to proceed with air raid precautions at an estimated cost of £600.

Linwood (Renfrewshire).—STREET LIGHTING.—The Renfrewshire Council has recommended the spending of £760 on adapting gas lighting standards in Linwood for electrical fittings and for the erection of thirty-eight new standards at a housing estate in accordance with the tender of Clyde Valley Accessories, Ltd.

Liverpool.—REWIRING MARKETS.—The Markets Committee is to rewire the St. Johns and wholesale fish markets to obtain a better lighting system. Two electric water heaters are also to be installed in the departmental offices at the St. Johns market.

London.—ISLINGTON.—A table of comparative statistics included in the Electricity Department's accounts for 1937-38 shows that there was a remarkable increase in the number of consumers, the total of 49,952 at the end of March being 6,739 more than a year before, reflecting the success of the Department's development campaign. The expansion of 7 million kWh (over 13 per cent) in sales was much greater than in the previous year, but the full effect of the new connections will, of course, not be revealed until the end of the current year. Between 1928 and 1936 the number of electric street lamps was only increased by 100 to 850, but since then it has risen rapidly to 1,542. There was a profit of £27,905 on the past year's working of the undertaking. The borough electrical engineer is Mr. A. P. MacAlister.

POPLAR.—Commenting on the results of the past year's working of the electricity undertaking in his annual report Mr. R. Illingworth, the borough electrical engineer and general manager, states that the most interesting fact illustrated by the tabulated statements is probably the continuous fall in the average price obtained per kWh sold. Excluding rentals, last year's average was 1.095d. per kWh. This proves very clearly, he says, that every effort has been made to provide a low tariff, and this position was maintained during the past year in spite of the adverse conditions. Sales increased by nearly 8 per cent. to 68 million kWh and the number of consumers by 1,912 to 33,213. The installation of cookers, washboilers and water-heaters continued to show splendid progress, the total connections at the end of March being 8,777, 2,689 and 1,576 respectively. On the engineering side Mr. Illingworth mentions that work has commenced on a new switchhouse at the Glaucus Street generating station. When this is completed in about twelve months' time, he says, the undertaking will possess one of the most modern switch-houses in the country. The building will include a new control room and modern switchgear of ample rupturing capacity, and will provide space for future switchgear to allow the high-voltage distribution system to expand comfortably for a considerable time. The layout of the switchgear is designed to provide physical isolation in the event of a major breakdown. The remaining three pulverised fuel boilers at the power station are in process of conversion to stoker firing. The undertaking's accounts for the past year show a net surplus of £19,751, which, although less than in the previous year, is considered very satisfactory in view of the prevailing conditions and the fact that tariffs were reduced at the beginning of the financial year under review.

Lytham St. Annes.—BURDEN OF ILLUMINATIONS.—Explaining how a loss of £1,855 had been incurred by the electricity undertaking during the past year, Councillor J. W. Horsfall, chairman of the Electricity and Transport Committee, stated recently that it was due largely to the cost of the illuminations, which amounted to £1,618, and which he thought ought to be a general charge, and not be borne by the Electricity Department. The undertaking was quite sound, and it was not proposed to increase the charges. The undertaking, he pointed out, had contributed largely towards the relief of the rates. Moreover, the change from DC to AC had cost £17,500, which had been met out of revenue.

Manchester.—ELECTRIC STREET LIGHTING.—In eight cases of new or additional illumination approved by the Public Lighting Sub-Committee of the Highways Committee electricity is to be used. In at least two instances electricity displaces gas, one being in Aytown Street, a busy city-centre thoroughfare adjoining Piccadilly Gardens. Here nine gas lamps are to be supplanted by six 500-W lamps. On the Matthews Lane estate, Levenshulme, eight gas lamps will be removed and thirteen 100-W electric lamps installed.

Marlborough.—TARIFF FOR COTTAGES.—A two-part tariff for cottage property of up to £10 rateable value was recently approved by the Council. There will be a fixed charge of 12s. a quarter and a running charge of 1d. per kWh, the tariff covering wiring for three lights and one plug.

Nottingham.—SITES FOR SUB-STATIONS.—The transfer to the Electricity Committee of land belonging to the Gas and Education Committees as sites for sub-stations has been approved by the Council.

Oxford.—LIGHTING SCHEME DEFERRED.—A £1,800 lighting scheme for London Road which the Highways Committee recommended was referred back by the City Council for further consideration last week.

Scunthorpe.—BULK SUPPLY.—The Electricity Commissioners have informed the Electricity Committee that they are satisfied generally as to the Council's proposals for taking a supply from the Central Electricity Board, and have given sanction to the borrowing of £22,100 to be expended on transformers and switchgear.

Shrewsbury.—TRANSFER OF UNDERTAKING TO J.E.A.—The Shrewsbury electricity undertaking was transferred to the West Midlands Joint Electricity Authority last week. When the transfer was decided upon by the Town Council earlier in the year one of the points emphasised was that for eight years from the date of the transfer the rates of charge in force in the Shrewsbury electricity area would not be increased, subject only to any general increase of charges in Shropshire in consequence of the increased costs.

Southend-on-Sea.—CAPTIVE BALLOON CAUSES SUPPLY FAILURE.—Two heavy surges on the bulk supply to Southend Corporation last Saturday were followed a few minutes later by its complete failure, which lasted from 7.49 to 8.5 p.m. This resulted in total interruptions of from 3 to 8 min. in the local DC lighting and from 2 to 22 min. in the traction, the delay in the latter case being due to the flashing over of a rotary. The cause of the surges was the fouling of the Barking-Rayleigh 132-kV lines by a captive balloon of the air defence of London which had broken away from its anchorage. The balloon then passed on to the Colchester-Rayleigh 132-kV lines, causing a shut-down at Rayleigh which was, previously to the failure, being supplied by the Barking-Colchester ring main.

Stalybridge.—ACQUISITION OF GLOSSOP UNDERTAKING.—The Stalybridge, Hyde, Mossley and Dukinfield Transport and Electricity Board has sent a letter to the Town Clerk stating that it is the intention of the Board to promote a Bill authorising the outright acquisition by the Board of the Glossop electricity undertaking of the Urban Electric Supply Co., Ltd. In view of this the Board would welcome the approval and support of the Corporation in the matter.

Tonbridge.—SUB-STATION.—A proposal has been made by the Electricity Committee for the erection of a sub-station at the rear of a store in Barden Park Road.

Wallsend.—SUB-STATION.—The erection of a sub-station in High Street is proposed by the North-Eastern Electric Supply Co., Ltd.

Walsall.—SUPPLY TO NEW ESTATE.—In order to give a supply of electricity to the Park Farm estate at Great Barr, where 1,200 houses are proposed to be erected, the Electricity Supply Committee is recommending that two transformer sub-stations should be provided on the estate at a total cost of £9,470. The Committee recommends that in connection with the erection of a further seventy-two houses on the Green Rock site, an additional sub-station should be provided in Abbotts Street, at an estimated cost of £1,850.

Whitby.—EXTENSIONS.—The electrical engineer is to proceed with mains extensions to twenty-seven houses on the Stainsacre Lane estate, thirty-six houses on the Castle Park estate and to the new isolation hospital.

Workington.—RURAL SUPPLIES.—The electrical engineer has submitted a report to the Electricity Committee upon a canvass in the Northside and Siddick areas, and has now been asked to prepare a detailed estimate of the cost of giving a supply to these districts.

Traction

Glasgow.—DECISION AGAINST TROLLEY-BUSES.—The Transport Committee has decided by eight votes to six that no experiments shall be made with trolley-buses as a sub-committee had recommended.

London.—TUBE STATIONS REOPENED.—The tube stations on the Northern and Bakerloo lines in the neighbourhood of the Thames that were closed on September 27th for "urgent structural alterations," were reopened on Saturday. The London Passenger Transport Board has not divulged the nature of the work, but *The Times* states that it is an open secret that the decision to strengthen certain parts of the underground workings was taken as a precautionary measure against the possibility of flooding from the river. While the existing structure was regarded as safe enough in ordinary times, it might not be equal to withstand the strain likely to be imposed in an emergency such as was visualised by the Air Raids Precautions Department of the Home Office. Many tons of concrete were placed in position, and the work of removing it has been going on since the tension caused by the crisis was relaxed. The possibility of making the workings safe by means of a system of watertight doors may be considered later by the Board's engineers.

Stalybridge.—TRAMWAY ABANDONMENT.—The Stalybridge, Hyde, Mossley and Dukinfield Transport and Electricity Board is to abandon various tramways in Stalybridge.

Communications

Australia.—TELEGRAPH LINE TROUBLES.—The 1,900-mile telegraph line between Port Augusta, South Australia, and Darwin, in the Northern territory, is one of the most difficult to maintain owing to the depredations of birds and white ants. Bunches of wire are now supplied so that magpies may build their nests without extracting pieces from the main line. The termite menace is more serious. Recently, repeated trouble was experienced with the main underground service near Darwin. Linesmen eventually found that this was due to termites which, after penetrating an inch of earthenware, had eaten their way through a thick coating of arsenic and vaseline. They then pierced the lead cable sheath a quarter of an inch thick, and finally ate the insulation off the telephone wires themselves.

France.—NEW RADIO STATION.—The low-powered radio station at Limoges is now to be equipped with a 100-kW transmitter operating on a wavelength of 328 metres.

Great Britain.—RADIO RELAYS.—A further decline in the number of subscribers to radio relay exchanges is shown by statistics that have just become available. At June 30th, 1938, there were 251,164 subscribers to 327 relay exchanges, compared with 253,272 subscribers to 327 exchanges at March 31st, 1938, the percentage of subscribers' licences to the total receiving licences issued being 2.91 and 2.94 respectively. In six districts the local relay systems have more than 5,000 subscribers. The annual general meeting of the Relay Services Association will be held on October 17th at the Holborn Restaurant, preceded by a luncheon.

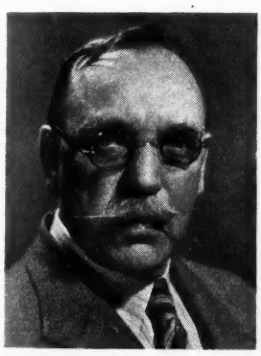
Greece.—NEW RADIO STATIONS.—The foundation stone of a new radio receiving station which is being built by a British company at Loutsa, near Athens, has been laid by M. Nicolopoulos, Under-Secretary of State for Posts, Telegraphs and Telephones. A transmitter will be built at Pallini, and it is estimated that the two stations will cost £70,000. It is hoped that they will be ready for operation with a year. According to the terms of the concession, the British company is to hand over the stations to the State at the end of fifteen years. All profits that are made during this period, after deduction of expenses, are to be divided between the company and the State.—*Reuter*.

United States.—TELEVISION.—A television transmitting station is to be constructed at a cost of £130,000 on top of the Chrysler building. The installation is expected to be completed early next year, and a viewing radius of over 40 miles is expected.

Personal and Social

Information regarding new appointments and other matters of interest for this page are welcomed

Mr. E. A. Joyce, doyen and manager of the travellers' department at the head office of the General Electric Co., Ltd., retired at the end of September, after a service with the company extending over forty years. Mr. Joyce joined the company in 1897, and after a period in the counting house, and some months with the West Kent Yeomanry in South Africa during the Boer War, he was appointed chief cashier. Following a subsequent term in the estimating department, his abilities as a salesman were applied as a special traveller, and his selection as manager of the travellers' department followed in 1917, a position he held until his retirement. During the war Mr. Joyce commanded the G.E.C. Cadet Corps, and both before and since that time he has taken the keenest active interest in the social and athletic activities of the company and the general welfare of the staff. He was one of the founders and most active original members of the Electrical Trades' Commercial Travellers' Association, of which he has served three times as chairman. His work on behalf of charitable institutions and the status of travellers has been an outstanding feature of his career. At a luncheon given to Mr. Joyce by the directors on September 30th he was presented with a silver salver by Lord Hirst and Mr. Railing, and on behalf of over 400 members of the staff of the company Lord Hirst also gave him a silver rose bowl with two vases to match, together with a book in which were inscribed the names of all those who had contributed. Tributes to Mr. Joyce's services with the company were paid to him by Lord Hirst and Mr. Railing, and Mr. Joyce replied.



Mr. E. A. Joyce

Mr. F. Wardrop, whose retirement from the position of London sales manager of the Midland Electric Co., Ltd., was announced in our last issue, informs us that he will still be actively engaged in the business of Hogan & Wardrop, Ltd., wholesale electrical suppliers, of which he is joint managing director.

Mr. C. D. Hanna, who has joined the staff of the Crompton-West Traction Organisation at Chelmsford, was assistant chief draughtsman in the steam locomotive department of Sir W. G. Armstrong Whitworth & Co. (Engineers), Ltd., for nine years prior to his appointment as chief locomotive and carriage designer on the inception of the company's Diesel traction department in 1930. He has been responsible for evolving the design of the railcars and locomotives (shunting and passenger) built by Sir W. G. Armstrong Whitworth & Co. (Engineers), Ltd., during the last eight years, including units for home railways, Argentina, Brazil, India, Australia, &c. As electrical transmission was invariably employed in these units Mr. Hanna is experienced in the technique associated with that type of drive. The Crompton-West Traction Organisation, covering the combined activities of Crompton Parkinson, Ltd., and Allen West & Co., Ltd., is not intending to undertake the manufacture of any mechanical parts of carriages or locomotives, but Mr. Hanna's extensive knowledge of railway traction will prove invaluable in the preparation of complete vehicle designs for both electric and Diesel-electric locomotives and carriages, for home and overseas railways.

Mr. T. A. Brandon, former London manager of John T. Cartwright & Sons, Ltd., has joined the board of Halsey's Electric Co., Ltd. This company, whose headquarters are at Stratford, E.15, has, owing to increasing business, vacated its City address at Knightrider Street and removed to more commodious premises at 17, Percy Street, Tottenham Court Road, W.1. Mr. Brandon is well known in the electrical industry, having been closely connected with Philips Lamps, Ltd., the Edison Swan Electric Co., Ltd., as well as other companies.

Mr. T. A. Brandon

Mr. G. B. Gill, A.M.I.E.E., general manager in China for the Hankow Light & Power Co., Ltd., is on his way back to Hankow in the s.s. *Rawalpindi* after some months' leave in this country.

Mr. R. D. Dawson has been appointed to the London sales staff of Bull Motors, Cecil Chambers, Strand. Mr. Dawson received his training at the company's works at Ipswich, and has subsequently held positions in the design and estimating departments there.

At a recent meeting of the Eccles Corporation Electricity Committee it was reported that the borough electrical engineer, **Mr. C. V. Johnson,** had been advised by a specialist to have treatment in a nursing home and that at least three

months' leave of absence would be necessary. The Committee made arrangements for the mains superintendent, **Mr. A. H. G. Burbridge**, and the commercial assistant, **Mr. F. Clark**, to take charge of the technical and commercial sides of the undertaking respectively during the absence of the engineer.

Mr. W. E. B. Nettleton is leaving the Salford Corporation Electricity Department to take up an appointment on November 1st as senior sub-stations engineer with the Sheffield Corporation Electricity Department. Before going to Salford thirteen years ago Mr. Nettleton was an erection engineer with the Metropolitan-Vickers Electrical Co., Ltd., his twelve years' service with that company including his apprenticeship with the British Westinghouse Co.

Mr. J. Ismay has resigned his directorships in the Ismay group of companies owing to continued ill health.

Mr. G. A. Guy, a member of the sales staff of Cryselco, Ltd., was elected a life governor of the Poplar Hospital for Accidents at the last meeting of the board, for services rendered.

To commemorate his year of office as Lord Mayor of the City of Birmingham **Councillor E. R. Canning**, J.P., chairman and managing director of W. Canning & Co., Ltd., entertained about 1,500 of the employés to a party at the Palais de Danse on October 10th. During an interval in the dancing the Lord Mayor and Lady Mayoress were presented with souvenirs of the occasion. The Lord Mayor was handed a silver casket containing an illuminated vellum scroll. The Lady Mayoress was presented with a platinum brooch bearing her initials in diamonds. The presentations were made by Mr. W. Griffin, who has been an employé of the company for about thirty-five years.

The annual dinner given by the Southern Division of the Electrical Power Engineer's Association is to be held on Saturday, November 5th, in the King's Hall, Holborn Restaurant, W.C.1, at 6.30 for 7 p.m. Dancing will follow until 1 a.m. The original intention was to hold the function on Saturday, October 1st, but it was postponed in view of the national crisis.

Obituary

Mr. Edmund L. Hill, M.I.Mech.E., M.I.E.E., who died in Melbourne, Australia, on September 15th, at the age of sixty-seven, was for many years well known in the electrical industry. After leaving school, he started his career as a pupil at the old London Brighton & South Coast Railway Co.'s engine shops, passing through all stages, including the drawing office, at the works, and later taking up electrical engineering. In the early days of the development of power companies he was appointed the first general manager of the South Wales Power Co. He afterwards joined the staff of Siemens Bros. & Co., Ltd., at their Manchester office, and later became manager of the branch. After being there for several years he became the general secretary of the Federation of British Industries, with the origin of which he was largely concerned. He was one of the original promoters of the Engineers' Club in Manchester, and later—together with a few friends—founded the Engineers' Club in London, of which he became secretary. Subsequently he left England and settled in Australia as the representative in that country of Wild-Barfield Electric Furnaces, Ltd., and some other leading British manufacturers.

Mr. H. Ford.—The death has occurred at Kirkwall of Mr. H. Ford, manager of the Corporation Electricity Department, who had been in indifferent health for some time. He was formerly an electrical engineer in the Royal Navy.

Will.—Lt.-Col. C. B. Clay, V.D., who played an active part in telephone development with the United Telephone Co. and the National Telephone Co., left £12,112, with net personalty £10,012.

Financial Section

New Companies. Official Returns of Capital. Debenture Charges. Reports of Electrical Companies. Dividend Announcements. Transactions in Stocks and Shares

New Companies Registered

Brush Coachwork, Ltd.—Private company. Registered October 4th. Nominal capital, £50,000. Objects: To acquire the business of coach builders carried on at Loughborough, Leics, being part of the undertaking of the Brush Electrical Engineering Co., Ltd. The directors are: H. E. Midgley, Royden Lodge, Lesney Park Road, Erith, Kent (director of Brush Electrical Engineering Co., Ltd.); T. B. Keep, 75, Park Road, Loughborough (managing director of Brush Electrical Engineering Co., Ltd); and W. C. T. Cran, 135, Rivermead Court, Hurlingham, S.W.6. Registered office: Bush House, Aldwych, W.C.2.

Aish & Co., Ltd.—Private company. Registered October 1st. Capital, £10,000. Objects: To carry on the business of electricians, electrical and mechanical engineers, manufacturers of and dealers in dynamos, motor armatures, magnetos, batteries, switchboards and general electrical plant, machinery and appliances, &c. The directors are: N. Aish, "Orchard Portman," 32, St. Albans Avenue, Bournemouth; and J. Johnson, "Chalfont," Canford Cliffs Avenue, Parkstone, Dorset. Registered office: Yelverton Road, Bournemouth.

Percliff Productions, Ltd.—Private company. Registered October 5th. Capital, £1,000. Objects: To carry on the business of mechanical, electrical and general engineers, manufacturers of and dealers in electrical apparatus, constructors of heating, ventilating, air conditioning and dust extraction plants, &c. The directors are: H. Perring, 37, The Grampians, Western Gate, W.6; and S. Clifford and Mrs. O. M. Clifford, both of 1, Evelyn Avenue, Ruislip. Secretary: O. M. Clifford. Registered office: 53, The Arches, South Harrow.

Electrical Power Repairs (Gillingham), Ltd.—Private company. Registered October 3rd. Capital, £2,000. Objects: To carry on business as manufacturers and repairers of and dealers in dynamos, motors, armatures, magnetos, batteries, &c. The directors are: W. Chas. Orrick (permanent), 52, May Road, Gillingham; J. Orrick and E. E. Orrick, both of 52, May Road, Gillingham; and G. E. Orrick, 48, Strover Street, Gillingham. Registered office: "Noss Mays," Strover Street, Gillingham, Kent.

Grensells, Ltd.—Private company. Registered October 3rd. Capital, £3,000. Objects: To acquire the business of electrical contractors carried on by Alfred L. Green and Arthur L. Sewell at 5, Lindsay Street, Kettering, as Grensells, and to carry on the business of electrical, heating, radio, sanitary, mechanical and general engineers, &c. The directors are: A. L. Green, 5, Spinney Lane, Kettering; and A. L. Sewell, "Pentire," Queen's Way, Wellingborough, Northants. Registered office: 5, Lindsay Street, Kettering.

Johnson, Pearce & Co., Ltd.—Private company. Registered October 4th. Capital, £500. Objects: To acquire the business of electrical contractors and mechanical and electrical engineers carried on by Frank Johnson and Harold W. Pearce at 4, Iverson Road, N.W.6, as Johnson, Pearce & Co. The permanent directors are: H. W. Pearce, 53, Barn Hill, Wembley Park, Mddx.; and F. Johnson, 36, St. Philip's Avenue, Worcester Park, Surrey. Registered office: 4, Iverson Road, Brondesbury, N.W.6.

Commercial Automatic Appliances, Ltd.—Private company. Registered October 8th. Capital, £10,000. Objects: To carry on the business of engineers, manufacturers of and dealers in electrical, mechanical or other automatic machines, refrigerators and cold storage machinery, &c. The directors are: C. Vanbergen, Lowfield Park, near Crawley, Sussex (chairman), and R. Porter, Lavrock, Horsted Keynes, Sussex. Secretary: C. Vanbergen. Registered office: Dorland House, 18-20, Regent Street, S.W.1.

Alex. R. McKay, Ltd.—Private company. Registered in Edinburgh on October 7th. Capital, £2,000. Objects: To carry on the business of general electrical, constructional and mechanical engineers, &c. The directors are: A. McKay, 41, Green, Aberdeen; and Mrs. J. McKay, 87, Mile End Avenue, Aberdeen. Registered office: 41, Green, Aberdeen.

J. T. Shawcross, Ltd.—Private company. Registered October 7th. Capital, £1,000. Objects: To acquire the business of J. T. Shawcross carried on by him as a registered electrical engineer and contractor at 1,118, Chester Road, Stretford, Lancs, and the business of F. Oldroyd carried on by him at 145, Cross Street, Sale, Ches, as a registered plumber and contractor. The first directors are: J. T. Shawcross and O. Shawcross, both of 1,118, Chester Road, Stretford, Lancs; and F. Oldroyd, 145, Cross Street, Sale, Ches. Registered office: 1,118, Chester Road, Stretford.

Banket Engineering Co., Ltd.—Private company. Registered October 7th. Capital, £3,600. Objects: To carry on the business of manufacturers of and dealers in boilers, turbines, winding engines, haulage plant, dynamos, motors, electrical plant and equipment, air-compressing plant and machinery, pumps, &c. The subscribers are: J. A. Wilkie, 19, Connaught Gardens, Muswell Hill, N.10; and A. Woodall, 66, Lonsdale Drive, Enfield West, Mdx. Registered office: 27b, Throgmorton Street, E.C.2.

F. W. Terry & Co. (Radio), Ltd.—Private company. Registered October 6th. Capital, £500. Objects: To carry on the business of manufacturers of and dealers in radio sets and apparatus, electrical, magnetic and galvanic apparatus and equipment, &c. The directors are: J. E. Mills, 18, Goodhart Way, West Wickham, Kent; and N. Lester, 7, Birkhall Road, Catford, S.E.6.

Thos. Lynn, Ltd.—Private company. Registered September 24th. Capital, £1,000. Objects: To acquire the business of a wireless dealer carried on by T. Lynn at 141, Chester Road, Sunderland, 9, Blandford Place, Seaham Harbour, and Picture House Buildings, Horden. The directors are: T. Lynn (permanent managing director) and Mrs. F. E. M. Lynn, both of "Everest," East Herrington, Co. Durham.

Sunbeam Vacuum Cleaner Co. (1938), Ltd.—Private company. Registered September 23rd. Capital, £3,000. Objects: To acquire the business of manufacturers of and dealers in vacuum cleaners and components and general electrical apparatus, previously carried on by the Sunbeam Vacuum Cleaner Co., Ltd. The directors are: H. E. Davis (chairman), 83, Fore Street, E.C.2; and P. G. Stirling, 35, Kelsey Way, Beckenham, Kent. Registered office: 83, Fore Street, E.C.2.

R. H. Hardie, Ltd.—Private company. Registered October 5th. Capital, £100. Objects: To carry on the business of manufacturers of or dealers in household and office goods, wireless and television apparatus, vacuum cleaners, fires, &c. The directors are: R. H. Hardie, 115, Birkhall Avenue, Glasgow, S.W.2; J. Hardie, 62, Trinity Avenue, Glasgow, S.W.2; and P. J. McKay, 58, Bath Street, Glasgow, C.2. Registered office: 14, Cursitor Street, Chancery Lane, E.C.4.

Returns of Electrical Companies

Calcutta Tramways Co, Ltd.—Capital, £1,400,000 in 450,000 preference and 950,000 ordinary shares of £1 each. Return dated May 24th, 1938. 250,000 preference and 700,000 ordinary shares taken up. £764,900 paid in cash, being 8s. per share on 22,000 ordinary, 10s. on 40,000 ordinary, 14s. on 11,000 ordinary and £1 on 409,100 ordinary and 250,000 preference shares. £185,100 considered as paid, being £1 per share on 118,900 ordinary, 12s. on 22,000 ordinary, 10s. on 40,000 ordinary and 6s. on 110,000 ordinary shares. Mortgages and charges,. £350,000 1st debenture stock and £250,000 2nd debenture stock.

Central Sussex Electricity, Ltd.—Capital, £260,000 in £1 shares. Return dated May 9th, 1938. 245,000 shares taken up. £239,000 paid, being £1 per share on 230,000 and 12s. per share on 15,000 shares. Mortgages and charges, nil.

Ceag, Ltd.—Capital, £1,000 in £1 shares. Return dated June 3rd, 1938. All shares taken up. £1,000 paid. Mortgages and charges, nil.

Colombo Electric Tramways & Lighting Co., Ltd.—Capital, £150,000 in 15,000 shares of £10 each. Return dated June 14th, 1938. 13,084 shares taken up. £840 paid in cash on 84 shares. £130,000 considered as paid on 13,000 shares. Mortgages and charges, nil.

A. & M. Goodman, Ltd.—Agreement dated September 24th, 1938, charged on benefit of all contracts now or at any future time entered into by the company for the preparation or manufacture and supply of signs as advertisements, to secure all moneys due from the company to the chargees (S.E. Finance Corporation, Ltd., of 25, Shaftesbury Avenue, W.1).

Midland Counties Electric Supply Co., Ltd.—Particulars filed of 3½ per cent. debenture stock to secure £1,750,000 authorised June 30th, 1938, and covered by trust deed dated September 21st, 1938, charged on share capitals and debenture issues in various power companies, and the company's undertaking and other property, present and future, including uncalled capital, but excluding shares and debentures in certain traction companies. The whole amount is now issued. Trustees: Trustees Corporation, Ltd. (The above ranks behind the charges created by trust deed dated March 31st, 1933.)

Lindley Thompson Transformer & Service Co., Ltd.—The nominal capital has been increased by the addition of £19,000 in £1 ordinary shares beyond the registered capital of £6,000.

Northern General Transport Co., Ltd.—The nominal capital has been increased by the addition of £132,000 in £1 ordinary shares beyond the registered capital of £1,000,000. To April 27th, 1938, 300,000 preference and 692,567 ordinary shares had been issued and fully paid up. The shareholders included British Electric Traction Co., Ltd., with 185,062 ordinary shares, and the L.N.E. Railway Co. with 304,267 ordinary shares.

Harvey (Electrical Engineers), Ltd.—Further Land Registry charge on 22, Fitzroy Square, and 4 and 5, Fitzroy Mews, W., dated September 6th, 1938, to secure £2,000. Holders: Pearl Assurance Company, Ltd.

Neon (Signs & Metalcraft), Ltd.—Deed of charge and covenants, dated September 1st, 1938, to secure all moneys which the chargee may be called upon to pay under a guarantee with Lloyds Bank, Ltd., not exceeding £1,500. Property charged: All moneys due or to become due to the company under hire-purchase agreement. Holder: T. J. Fox, "Stanwell," Mayland Road, Bedhampton, Hants.

Hobart Manufacturing Co., Ltd.—The nominal capital has been increased by the addition of £125,000 in £1 ordinary shares beyond the registered capital of £75,000. At August 24th, 1937, the Hobart Manufacturing Co., of Troy, Ohio, U.S.A., held 55,476 shares out of 56,027 shares issued. They were allotted a further 68,295 shares (out of 68,973 issued) by way of "bonus" on September 15th, 1938.

Universal Distributing Co., Ltd.—The capital has been increased from £100 to £12,600. 12,500 £1 ordinary shares have been allotted and taken up for cash.

Mersey Electrics, Ltd.—A. K. Jones, of 43, Regent Street, Wrexham, ceased to act as receiver and/or manager on September 29th, 1938.

Sunbeam Vacuum Cleaner Co., Ltd.—H. E. Davis, Incorporated Accountant, of 83, Fore Street, E.C.2, was appointed receiver and manager on September 13th, 1938, under powers contained in debentures dated December 10th, 1934.

Electronaire Marketing Co., Ltd.—J. A. Caldwell, of Elmdene, Pinner, was appointed receiver and manager on September 27th, 1938, under powers contained in debenture dated April 8th, 1938.

Ashton Electrical Co. (Preston), Ltd.—Hugh Southworth, of 9, Chapel Street, Preston, ceased to act as receiver and manager on August 10th, 1938.

City Notes

Ismay Industries, Ltd.—In announcing the resignation of Mr. John Ismay from the directorships of the Ismay group of companies, owing to ill-health, the Board states in a circular to shareholders that on the instruction of the board, Price, Waterhouse & Co., accountants, have been making an investigation for the past two months of the company's affairs. While this investigation has not yet been completed, it is already apparent that there are investment losses which will have to be written off. It is intended to strengthen the directorates of all boards of the group, and the changes will be announced in due course. The next accounts of the company are being prepared by its auditors, Franklin Wild & Co., in conjunction with Price, Waterhouse & Co., and will be made up to the end of the current month to enable the board to submit the fullest possible report to shareholders at the annual general meeting which will be held at the end of December. Mr. J. Ismay's directorships include: A. C. Cossor (joint managing director), Braemore Trust, Britannia Electric Lamp Works (chairman), F. Francis & Sons, Ltd., Ismay Cables (chairman), Ismay Industries (chairman and managing director), John Ismay & Sons. Ltd. (chairman), Tungsten Manufacturing Co., Ltd. (chairman), and Webbs Crystal Glass Co. Ismay Industries, Ltd., owns 99 per cent. of the ordinary capital of John Ismay & Sons. The company's subsidiaries and associates include Sterling Works (Dagenham), Ismay Distributors, Sterling Batteries, Ltd., Sterling Clocks, Hire Purchase Corporation, Trutolife Television, Ltd., Halcyon Radio, Ltd., Ismay Refrigeration Co., Ltd., Ismay Cables, Ltd., and Kniveton Cable Works, Ltd. In the last balance sheet at June 30th, 1937, interests in subsidiary companies appeared at £708,453, comprising £679,193 shares, £15,050 debentures and £14,210 current accounts. Interests in associated companies were shown at £301,589, including £160,050 shares, £25,500 debentures and £116,039 current accounts.

The Callender-Crompton Scheme.—Callender's Cable & Construction Co., Ltd., has issued a circular to shareholders stating that owing to the recent crisis and to the consequent unsettled condition of world trade and finance the directors of the company and of Crompton Parkinson, Ltd., have mutually agreed that it would be inadvisable to proceed with the negotiations for a closer working of the interests of the two companies. These negotiations, which have been carried on with that friendly spirit which has always characterised the dealings between the two companies, are now closed.

The Shanghai Electric Construction Co., Ltd., has announced that, having regard to local conditions and their effect on the company's results, the directors have deemed it prudent not to declare an interim dividend, but to leave the matter of dividends for consideration when the accounts for the year are available. In the preceding year there was an interim dividend of 2 per cent.

The London Passenger Transport Board announces a final payment of interest on London Transport "C" stock for the year ended June 30th at the rate of 2½ per cent., less tax at 5s. 6d., making a total of 4 per cent. for the year. The sum of £26,202 remaining after the payment of this interest, being less than one-eighth of one per cent. on the London Transport "C" stock outstanding, has been transferred to the London Transport "C" stock interest fund.

The Perak River Hydro-Electric Power Co., Ltd., reports a net revenue for the year ended July 31st of £331,893, as compared with £339,753 in the preceding year, to which is added £3,908 brought in, making £335,801. From this the following deductions are made: Guaranteed debenture stock interest, £43,255; guaranteed debenture stock sinking fund, £49,240; depreciation, £50,760; reserve, £20,000: provision for staff pension fund, £4,000; and preference share dividend for the year, £62,500. It is proposed to pay an ordinary dividend for the year of 6 per cent. (against 7 per cent.) and to carry forward £24,921 (subject to directors' further remuneration). It is also proposed to create 500,000 new shares of £1 each to be called, while unissued, "A" shares, and to be available for issue either as preference or ordinary shares. The report states that during the greater part of the year a considerable proportion of the company's output was generated by the steam stations, but owing to reductions in the permitted output of the tin mines in its area the whole of the load during recent months has been supplied by the hydro-electric plant. Meeting: October 19th.

Wilkes Berger Engineering Co., Ltd.—At an extraordinary meeting held last week resolutions were passed increasing the capital to £160,000 by the creation of 60,000 5½ per cent. redeemable cumulative preference shares of £1 each. Mr. F. W. Wilkes (chairman), in submitting the resolutions, said that in November last year they acquired the whole of the share capital of Beethoven Electric Equipment, Ltd. This company had introduced further models in the fields of domestic electrical appliances and internal telephone communications which so far had met with success, and they had ready various new articles waiting for quantity production and marketing. A short time ago it was found possible to obtain another modern factory immediately adjoining their present works at Acton, and the directors had decided to formulate a scheme for the concentration and co-ordination of all their London premises at Acton. The cost of the whole scheme was estimated at £35,000, thus giving them a further £25,000 for additional working capital. The issue had been underwritten by the Prudential Assurance Co. at a commission of 2½ per cent.

Herbert Morris, Ltd., in a preliminary statement, reports a profit for the year ended July 31st of £203,325, as compared with £175,047 for 1936-37. These figures have been struck before deducting depreciation and directors' fees. The final ordinary dividend is 27½ per cent., tax free, making 32½ per cent. for the year (against 27½ per cent.), reserve receives £20,000, and £20,143 is to be added to the "carry-forward," making it £70,366.

The Tata Power Co. reports profits for the year ended June 30th of Rs.54,12,134, as compared with Rs.34,10,779 in 1936-37. Out of the year's earnings the directors have provided Rs.36,500 as a bonus to the staff, written off debenture discount, &c., amounting to Rs.6,04,998, and made transfers of Rs.10,42,000 to taxes reserve and Rs.5,00,000 to general reserve. The final ordinary dividend is Rs.35 with a bonus of Rs.15, both tax free, making a total distribution for the year of Rs.75 (against Rs.60), and Rs.4,37,451 is carried forward (against Rs.4,68,997 brought in). The power sales of the company amounted to 302,823,765 kWh, an increase of 37.05 per cent. over the preceding year.

The Andra Valley Power Supply Co. shows a profit of Rs.23,12,254 for the year ended June 30th, as compared with Rs.21,82,643 for the previous year. The ordinary dividend is maintained at Rs.75 per share by the final payment of Rs.45, tax free. A sum of Rs.18,136 is placed to special repairs reserve, Rs.4,32,000 to taxes reserve, and Rs.3,00,000 to general reserve. The balance carried forward is Rs.3,80,717 (against Rs.3,85,330 brought in). The report states that many of the company's textile consumers worked on an overtime or double shift basis throughout the year, and as a result the power sales of the company were up to the full rated saleable capacity of 180,000,000 kWh.

Murex, Ltd., reports a trading profit for the year ended June 30th last of £346,657, as compared with £303,501 in the preceding year, to which is added other income totalling £83,198, making a total of £429,855. After providing for obsolescence reserve and taxation reserve, it is proposed to maintain the ordinary dividend at 20 per cent., to place £100,000 to reserve, and to carry forward £90,463 (against £110,113 brought in). The report states that the extensive additions to the factory and plant which have been in course of construction during the past few years are now practically completed.

Erinoid, Ltd., reports a net profit for the year ended July 31st of £14,605, after allowing £6,690 for depreciation, as compared with a profit in the previous year of £23,075, to which is added £4,846 brought in. An interim dividend of 2 per cent. was paid last May, but as already announced no final distribution is recommended. The balance carried forward is £8,821. For the previous year the final dividend on the ordinary shares was 5 per cent., making 8 per cent. for the year. The report states that the trading results for the first half-year showed a slight improvement on the corresponding period of the previous year. This was not maintained during the remainder of the year.

Max Stone, Ltd., have announced a first and final dividend of 10 per cent., less tax (against 17½ per cent.).

The Ever Ready Trust Co., Ltd., is paying an interim dividend of 3 per cent. on both the ordinary stock and the deferred shares (same).

The Oriental Telephone & Electric Co., Ltd., has declared an interim dividend of 4 per cent., tax free (same).

Stothert & Pitt, Ltd., proposes to pay a dividend of 10 per cent. and a cash bonus of 2½ per cent. on the ordinary shares for the year to June 30th (unchanged). The profit for the year is £66,230 (against £65,218), and £30,000 is placed to reserve.

The British Oxygen Co., Ltd., has declared an interim dividend of 7 per cent. on the ordinary stock (same).

The Calcutta Electric Supply Corporation, Ltd., has declared an interim dividend on the ordinary stock of 4 per cent. (actual), free of tax.

Babcock & Wilcox, Ltd., have declared an interim ordinary dividend of 4 per cent. (unchanged).

Edmundsons Electricity Corporation, Ltd., reports that the results of the operations of its group of companies during September, as compared with the corresponding month of 1937, show an increase of 11 per cent. in kWh sold.

Stocks and Shares

TUESDAY EVENING.

STOCK Exchange market conditions are getting into a more settled state now that the crisis is already a fortnight old. The volume of business in the Stock Exchange has increased to something like normal proportions. On one of the worst days the number of transactions recorded dropped below 3,000; on Monday in this week the figure has risen to 7,800. Prices have recovered in most departments. A great part of the previous fall is wiped out and, in spite of trepidation in regard to the Budget next spring, gilt-edged prices hold their ground under the influence of consistent support from big houses.

In the gilt-edged market there is little evidence that confidence in ordinary shares has returned far enough to deprive safety-first investments of their following. War Loan has advanced this week from 101 to 101⅛, and others in the trustee lists are generally harder. No impression was made on the London Transport senior stocks by the "C" stock dividend decision. Changes in Central Electricity Board issues are negligible. The switchback movements in London and Home Counties 4½ per cents. and West Midlands fives were continued with a rise in the former from 97½ to 109⅛. These firm conditions are the more notable because of the widespread recognition that a somewhat thorny path appears to lie ahead of the gilt-edged market. Possibilities of higher taxation, and further Government borrowing to meet the cost of the crisis and of the acceleration of rearmament, are not calculated to gladden the hearts of holders of gilt-edged stock.

Transport "C" Stock

Holders of London Transport Board "C" stock are being given a final dividend making 4 per cent. for the year, and the chance of applying for the appointment of a receiver if they so will. This right is the stockholders' compensation for the failure of the Board to pay the statutory 5½ per cent. dividend due this year. Some people had expected a skimping, for once, of the heavy reserve allowances to cover the comparatively small cost of the extra dividend and the risk of a receivership. Most had expected that last year's 4½ per cent. would be at least maintained. Disappointment with the actual rate expressed itself in a sharp drop in the price of the stock. After having been run up to 77½ just before the announcement, the stock changed hands down to 70 before rallying to 72 ex dividend. Heavy increases in working costs are regarded as the only explanation for a cut in the dividend in the face of an improvement of £650,000 in the year's gross receipts. The chairman, Lord Ashfield, has stated that the annual report, to be published on the 28th of this month, will contain a comprehensive review of the affairs of the Board since its formation five years ago. Pending some unexpected news the market's inclination is to value the stock as being for some way ahead on a 4 per cent. dividend basis. A yield of 5½ per cent. seems to support this view. The shares of Thomas Tilling, Ltd., which holds a large block of the stock, are 9d. down at 45s.

Callenders and Cromptons

Callender's shares have been the weak spot in an otherwise steady market for electrical equipment shares. Some inkling of a hitch in the negotiations for a partnership between the company and Crompton Parkinson was evidently abroad before the actual announcement, which found Callenders already 3s. 9d. down at 4⅞. Later the shares weakened further to 4½, ex the interim dividend. That Cromptons should have remained unmoved at 25s. indicates in which direction the principal benefits of the partnership had been expected to fall. Disturbances in world trade and finance, as a result of the crisis, are given as the explanation for the dropping of the negotiations.

The original intention, as expressed in last July's circular, was for a closer working arrangement involving the formation of a holding company into whose stock the members of both companies would be invited to exchange their holdings. Friendly relationships between the two are said to have been maintained.

Brush Shares and Options

Dealings have started, at around par, in the 150,000 new £1 ordinary shares issued last week to Brush Electrical Engineering stockholders. The shares are to be converted, later on, into 5s. stock units, and will then rank equally in every respect with the existing stock. With the allotment letters for the new shares, stockholders received option certificates giving the right to subscribe for shares at par, on a one-in-three basis, at any time up to September, 1943. The period between now and then will cover the reorganisation of the Brush works to which the Petter Company's equipment is now being transferred, and the first few years' working of the amalgamation of the two companies. Brush have lately reported a strong revival of business, and there are high expectations regarding the fruits of the merger with Petters. It is expected accordingly that the rights given by the option certificates may prove to be well worth having before the date of expiry. They are changing hands at about 2s. 6d. for each £1 of option.

American Conditions

Overshadowed for a time by the European events, American news has again taken up a position of major importance to London markets. Business activity in that country grows at a pace very encouraging to those who look to America for the much-needed stimulus to world trade. Free from immediate anxiety in the direction of Europe, Wall Street has returned to domestic affairs with a show of optimism over the progress and outlook. Relief appears to have generated more activity than is being seen in our own markets. Also, the rise in prices has gone ahead until now the majority of quotations can scarcely be justified by the present state of trade. As usual, American speculators are discounting future developments, and there is talk of inflationary consequences to the staggering budget deficits which are being built up out of the Administration's expenditure on works and relief. In this country, there are misgivings over what will happen at the end of the spending programme. Apparently this is a too distant matter to place, as yet, a curb on Wall Street bullishness.

Share List

Our weekly share list of electrical companies is expanded this week to take in a larger section of a wide and growing field of investment. The number of shares listed has been roughly doubled, and columns have been added to show the highest and lowest prices recorded this year to date. To the home electricity supply group is added a selection of overseas companies of interest to investors in this country. Additions have been made to the other groups, particularly so far as the manufacturing and equipment shares are concerned, to bring in securities which, although not always among the market leaders, have a considerable following. Introduction of the highest and lowest columns is made in order to provide information on a point of general interest, and one upon which people place a good deal of store.

As it happens, many of the low points were touched within a short time of the new tables' appearance, and it is a happy circumstance that the list of current prices has already left the "lows" well behind.

Miscellaneous Matters

Enfield Cables, at 2½, are ¼ lower, but the equipment and manufacturing group as a whole has been successful in consolidating the post-crisis revival. Recovery in the electricity supply market had apparently overreached itself at some points, and a few prices are 6d. or 1s. lower. Victoria Falls, at 72s. 6d., again show up well in the overseas section. Cable and Wireless stocks went ahead strongly on the expectation of a fillip to communication traffics resulting from Wall Street activity and from such improvement in international trade as may follow the Munich settlement. The price of the ordinary stock has advanced from 42½ to 45; the preference is 90, ex-dividend. Ismay Industries shares had a further relapse to 1s. 6d. on the auditors' report that investigation of the company's affairs had disclosed investment losses which will have to be written off. The annual meeting has been fixed for December.

Electrical Companies' Shares

Prices, dividends and yields

Company	1938. High-est.	1938. Low-est.	Dividend. Pre-vious.	Dividend. Last.	Price Oct. 11.	Rise or Fall.	Yield p.c. £	s.	d.
Home Electricity Companies.									
Bournemouth and Poole...	68/3	62/–	15	15	67/6	+⅛	4	8	7
British Power & Light ...	30/9	24/6	6	7	28/6	—	4	18	3
City of London	34/6	28/6	7½	7½	31/–	—	4	16	9
Clyde Valley	42/6	33/–	8	8	35/9	—6d.	4	9	4
County of London ...	51/9	38/9	10½	10½	46/6	—1/–	4	10	5
Edmundson's :									
7% Pref.	33/3	30/–	7	7	32/6	—	4	6	2
Ord.	40/9	18/9	9	9	26/–	—6d.	—		
Elec. Dis. Yorkshire ...	43/6	37/9	9	9	42/6	—	4	4	8
Elec. Fin. and Securities...	51/9	49/–	12½	12½	50/–xd.	+9d.	5	0	0
Elec. Supply Corporation...	55/–	50/–	12	12	53/9	—	4	9	5
Isle of Thanet	21/3	18/6	4	4	20/–	—	6	0	0
Lancs Light and Power ...	35/–	26/–	7½	7½	31/3	—	4	16	0
Llanelly Elec.	23/6	21/–	5½	5½	21/6	—	5	2	4
Lond. Assoc. Electric ...	32/9	28/–	7	7	30/9	—	4	11	4
London Electric	36/3	32/–	8	10	34/–	—	4	2	4
London Power Deb. Red.	108¾	100	5	5	105	+1½	4	15	3
Metropolitan	51/–	41/–	10	12	47/6	—	5	1	1
Midland Counties	39/9	33/–	8	8	37/6	—	4	5	3
Mid. Elec. Power	41/9	37/–	8	9	40/9xd.	+6d.	4	8	3
Newcastle Elec.	31/9	27/6	7	7	30/–	—	4	13	4
North Eastern Electric :									
Ordinary	34/–	25/–	7	7	32/–	—	4	7	6
7% Pref.	34/–	30/–	7	7	32/–	—6d.	4	7	6
Northampton	47/6	43/9	10	10	46/3	—	4	6	7
Notting Hill 6% Pref. (£10)	14	13½	6	6	13½	—	4	9	0
North Met. Elec. :									
Ordinary	49/–	43/–	10	10	47/6	—9d.	4	4	3
6% Pref...	30/6	28/3	6	6	29/6	+6d.	4	2	9
Richmond Elec.	30/6	28/–	7	7	28/9	—	4	17	5
Scottish Power	38/9	32/–	8	8	37/–	—	4	6	6
Southern Areas	22/9	18/6	4½	5	21/3	—	4	14	1
South London	32/6	31/–	7	7	31/6	—	4	9	0
West Devon	23/3	21/6	5	5	1½	—	4	9	0
West Glos.	18/6	16/9	2	2	18/–	—	2	4	5
Yorkshire Elec.	42/–	36/9	8	8	41/–	+6d.	3	18	3
Overseas Electricity Companies.									
Calcutta Elec.	44/3	36/3	12*	10*	1¼xd.	+6d.	5	6	8
Cawnpore Elec.	40/–	35/–	10	10	36/3	—	5	10	6
East African Power ...	28/3	22/6	7	7	26/–	—	6	5	0
Atlas Elec.	4/6	2/6	Nil	Nil	3/3	—	—		
Jerusalem Elec.	26/9	23/3	5	6	25/–	—6d.	4	16	1
Palestine Elec. "A" ...	31/9	27/–	7½*	7½*	28/9	+⅛	5	14	2
Kalgoorlie (10/–)	2/–	9/6	7½	7½	10/9	—	6	19	6
Madras	34/6	28/9	8*	8*	30/–	—	5	6	8
Perak Hydro-electric ...	25/3	17/–	7	6	20/–xd.	—	6	0	0
Victoria Falls Power ...	76/3	55/–	12	13½	72/6	+⅛	3	14	7
Shawinigan Power ...	23½	16½	65cts.	85cts.	22½	+1½	—		
Montreal Power	31¼	26½	1½	1½	31/3	+⅜	—		
Whitehall Investments Pref.	22/3	15/–	7½	7½	18/9	—	8	0	0
Tokyo Elec. 6%	65½	39	6	6	52½	+5	11	8	6
Public Boards.									
Central Electricity :									
1950–70	115⅝	97	5	5	111	—	4	10	1
1955–75	118½	100	5	5	112½	—	4	9	0
1951–73	111	95	4½	4½	109½	—	4	2	2
1963–93	101	85	3½	3½	98	—	3	11	5
London Elec. Trans. Gtd.	93½	88	2½	2½	91½	—	2	14	8
London & Home Counties,									
1955–75	112½	97½	4½	4½	110	+12½	4	1	10
Lond. Passenger Transport :									
A	119½	114⅝	4½	4½	116½	—	3	17	4
B	122⅝	115½	5	5	116½	—	4	5	10
C	84	68	4½	4	72½xd.	—2	5	10	4
West Midlands Joint Elec.,									
1948–68	115½	102½	5	5	102½	—	4	17	6
Telegraph and Telephone.									
American Tel. & Tel. ...	154⅛	114	9	9	154⅛	+5	5	16	6
Anglo-Am. Tel. :									
Pref.	115½	104	6	6	106½	—	5	12	7
Def.	28	24	1½	1½	25	—	6	0	0
Anglo-Portuguese ...	23/6	19/3	8	8	22/6	+⅛	7	2	3
Cable & Wireless :									
5½% Pref.	104	84	4½	5½	90xd.	—	6	2	3
Ord.	67⅞	36	—	4	45	+2½	8	17	10
Income	102½	99	—	—	101	—	3	18	2
Canadian Marconi $1 ...	6/6	3/9	—	Nil	5/–	+9d.	—		
Globe Tel. & Tel. :									
Ord.	32/6	27/6	5½*	7½*	30/–	—	5	0	0
Pref.	27/6	23/9	6	6	26/3	—	4	11	5
Great Northern Tel. (£10)	42½	31/–	20	20	41	—	4	17	7
Marconi-Marine	30/6	21/6	10	7½	23/9xd.	+6d.	6	6	4
Oriental Telephone Ord. ...	59/3	2½	12*	12*	57/6	—	4	3	8
Radio Corpn.	8	4⅜	8	6	8½	+1/16	—		
Telephone Props	13/9	11/3	5	6	13/9	—	8	14	6
Telephone Rentals (5/–) ...	10/–	7/6	5	6	9/–	—	3	6	8
Western Union	34½	25	2½	—	31½	+2	—		
Traction and Transport.									
Anglo-Arg. Trams :									
First Pref.	11/–	2/6	Nil	Nil	3/9	—	—		
4% Inc.	31	8	Nil	Nil	9	—	—		
British Electric Traction :									
Def. Ord.	1060	675	5	5	950	—25	—		
Pref. Ord.	175	150	8	8	165	—	4	17	0
Bristol Trams	45/–	34/3	5	8	38/9	–⅛	4	2	9
Brazil Traction	14½	7⅛	70 cts.	$1	12⅝	—	—		
Calcutta Trams	26/9	21/6	8	8	23/–xd.	+1/16	6	19	2
Cape Elec. Trams ...	18/6	15/6	5	6	17/6	—	6	17	2
Lancs Transport	35/3	29/3	10	10	32/6	+⅛	6	3	1
Mexican Light :									
1st Bonds	39	16½	5	5	20	—½	—		
Rio 5% Bonds	91	47	5	5	63	+3	7	18	9
Southern Rly. :									
5% Prefd.	87	48	5	—	54½	—	7	9	0
5% Pref.	116	83	5	5	94½	—	5	5	10
T. Tilling	60/–	36/6	10	10	45/–	—9d.	4	9	0
Tilling & B.A.	57/–	2½	6	10	50/–	—	4	0	0
West Riding	46/3	30/6	10	10	32/6	—	—		
Equipment and Manufacturing.									
Aron Electricity Ord. ...	40/3	31/–	15	15	1 1/16	—	8	17	6
Assoc. Elec. :									
Ord.	45/3	32/–	10	10	38/6	+6d.	5	4	0
Pref.	38/9	35/6	8	8	36/–	—1/6	4	9	0
Automatic Telephone & El.	43/–	35/–	5	10	41/3	+⅛	4	17	1
Babcock & Wilcox ...	44/–	37/–	10	10	38/9xd.	+1/6	5	3	1
British Aluminium Ord. ...	54/–	40/–	10	12½	50/–xd.	—6d.	4	17	6
British Insulated Ord. ...	95/9	77/–	20	20	4½	—	4	9	0
British Thermostat (5/–) ...	15/6	9/–	17½	18½	11/3xd.	—6d.	8	4	6
British Vacuum Cleaner...	35/9	27/6	5	6	30/–	—	4	0	0
Brush Ord....	5/6	4/9	Nil	Nil	5/3	—6d.	—		
Callender's	5½	78/6	20	20	4½xd.	–⅛	4	14	4
Chloride Elec. Storage ...	77/9	61/–	15	20	75/–	—	5	6	8
Consolidated Signal ...	116/–	75/–	30	36½	4½	—	8	2	0
Crabtree (10/–)	29/–	22/–	—	17½	23/9	—	7	9	6
Crompton Parkinson :									
Ord. (5/–)	32/3	18/9	12½	12½	25/–	—	—		
E. K. Cole (5/–)	8/9	4/6	5	10	7/–	—	7	2	10
Elec. & Musical Industries (10/–)	16/3	9/–	10	5	11/–xd.	—	4	11	0
Electric Construction ...	36/–	31/–	10	12½	32/6	—	7	13	10
Enfield Cable Ord. ...	5⅝	46/–	25	25	2½	–⅛	—		
Electrical Switchgear ...	26/3	24/–	5	5½	25/–	—	4	8	0
English Electric	31/9	24/6	Nil	10	30/–	—	6	13	4
Ensign Lamps (5/–) ...	14/3	11/3	—	10	13/6	+6d.	7	8	2
Ericsson Tel.	2⅛	31/–	25*	25*	2xd.	+1/6	3	2	6
Ever Ready	26/3	16/6	45	35	18/6	—	9	9	2
Falk Stadelmann	34/3	27/–	10	10	27/6	—	7	5	6
Ferranti Pref.	27/6	25/6	7	7	27/6	—	5	2	0
G.E.C. :									
Pref.	34/–	31/3	6½	6½	31/3	—	4	3	4
Ord.	79/3	67/–	17½	20	77/6	+6d.	5	3	1
Greenwood & Batley ...	25/6	19/–	7	15	25/–	—	12	0	0
Hall Telephone (10/–) ...	24/6	18/3	5	15	18/9	–⅛	8	0	0
Henley's (5/–)	21/–	16/–	15	20	20/–	—	5	0	0
4½% Pref.	23/–	21/3	4½	4½	22/6	—	4	0	0
Hopkinsons	40/–	32/6	10	12½	37/–	—	6	15	2
India-Rubber Pref. ...	21/9	20/3	5½	5½	21/3	—	5	3	6
Intl. Combustion	5⅜	4½	5	30	5½	—	5	17	1
Ismay Industries (5/–) ...	6/9	1/6	6	6	1/6	—9d.	—		
J. Lucas	57/9	47/6	15	15	55/–	—⅛	5	9	1
Johnson & Phillips ...	43/9	32/6	10	12½	37/6	—	6	13	4
Lancashire Dynamo ...	72/3	53/–	20	25	55/–	—	9	4	0
Laurence Scott (5/–) ...	12/–	9/–	7	15	10/6	—	7	2	10
London Elec. Wire ...	35/–	27/6	12	7½	28/9	–⅛	5	4	2
Mather & Platt	49/–	41/3	12	13½	46/3	+⅛	5	17	0
Metropolitan Elec. Cable Pf.	22/–	21/–	5½	5½	21/3	—	5	3	6
Murex	93/9	63/3	12	20	76/3xd.	—	5	4	9
Pye Deferred (5/–) ...	12/–	8/–	5	25	9/6	—	13	17	10
Revo (10/–)	36/3	30/–	12	17½	32/6	—	5	7	8
Reyrolle	62/6	49/–	12½	12½	56/3	—	4	9	0
Siemens Ord.	31/–	20/6	7½	7½	23/9	—	6	6	4
Strand Elec. (5/–)... ...	6/–	4/–	5	5	4/6	—	11	2	0
S. Smith (1/–)	9/9	6/3	37½	50	8/9	—	6	6	0
Switchgear & Cowans (5/–)	19/6	12/6	20	20	15/–	—	6	13	4
Telegraph Condenser (10/–)	18/9	12/–	5	5	12/6	—	4	0	0
Telegraph Construction ...	2½	36/–	7½	10	2¼	—	4	9	0
Telephone Mfg. (5/–) ...	9/9	7/–	9	9	9/–	—	4	0	0
Tube Investments ...	89/6	70/–	17½	23⅜	4½	+¼	5	15	6
Vactric (5/–)	9/9	5/9	10	10	7/–	—	7	2	10
Vickers	27/–	17/6	10	10	21/6	+⅛	4	13	0
Westinghouse Brake ...	63/9	45/–	15	17½	2¾	+¼	6	7	3
Walsall Conduits (4/–) ...	27/9	20/6	6½	55	23/9	—9d.	9	5	0
West, Allen (5/–)	7/–	4/3	—	7½	5/6	—	6	16	4

* Dividends are paid free of Income Tax.

New Patents

Electrical specifications recently published

Compiled by a firm of chartered patent agents. The numbers under which the specifications will be printed and abridged are given in parentheses. Copies of any specification (1s. each) can be obtained from the Patent Office, 23, Southampton Buildings, London, W.C.2.

1936

34087. "Illumination of dials of instruments." P. Kollsman. December 11th, 1935. (492092.)

34106. "Optical sound-recording." Klangfilm Ges. December 11th, 1935. (491956.)

1937

118. "Electrical resistance thermometers." J. S. Pont and Imperial Chemical Industries, Ltd. January 3rd, 1938. (492093.)

535. "Excitation control of electric generators." H. O. Burge, D. C. H. Mathews and Crompton Parkinson, Ltd. January 7th, 1937. (492094.)

1317. "Electric cables." Okonite Co. January 15th, 1936. (492158.)

3781. "Method of and machine for manufacturing fine wires having a reduced diameter portion between the ends." J. H. Eccleston and H. Hart. February 9th, 1937. (492031.)

3862. "Radio beacons." Soc. Anon. des Ondes Dirigées. February 14th, 1936. (491963.)

4067. "Spot-lighting attachment for lighting fittings." G. Campbell and Benjamin Electric, Ltd. February 11th, 1937. (491964.)

5652. "Automatic circuit-breaking device for use on internal-combustion engines." A. H. Bailey. October 14th, 1937. (492034.)

6898. "Electric motor control systems." General Electric Co., Ltd., H. J. Coates and J. W. Gibson. March 9th, 1937. (Cognate application 9449/37.) (492096.)

7017. "Sorting apparatus." Electric Selectors, Ltd., and W. R. Horsfield. February 9th, 1938. (492035.)

7060. "Light-sensitive electrodes." H. G. Lubszynski and L. Klatzow. March 10th, 1937. (492036.)

7061. "Electro-optical image converting or transmitting arrangements." H. G. Lubszynski and H. Miller. March 10th, 1937. (492167.)

7107. "Apparatus for feeding articles in sorting and like machines." Electric Selectors, Ltd., and W. R. Horsfield. March 10th, 1937. (492037.)

7157. "Lighting fittings." G. Campbell and Benjamin Electric, Ltd. March 11th, 1937. (492100.)

7158. "Lighting fittings." L. R. Kavanagh and Benjamin Electric, Ltd. March 11th, 1937. (492101.)

7193. "Television receiving arrangements." Radioakt.-Ges. D. S. Loewe. March 16th, 1936. (492168.)

7200. "Electrical impedance networks." Telefonaktiebolaget L. M. Ericsson. April 23rd, 1936. (Addition to 417386.) (492103.)

7329. "Electric motor control." British Thomson-Houston Co., Ltd., and B. Adkins. March 12th, 1937. (492105.)

7338. "Electric cables." Standard Telephones & Cables, Ltd., and A. W. Gent. March 12th, 1937. (492333.)

7354. "Electric relays of the impedance type." Compagnie pour la Fabrication des Compteurs et Matériel d'Usines à Gaz. March 13th, 1936. (492172.)

7421. "Electric contact devices." A. Reyrolle & Co., Ltd., F. H. Groom and C. S. Lawson. March 13th, 1937. (492040.)

7456. "Electrically operated sound-producing signalling or warning apparatus." J. Lucas, Ltd., T. A. Harris and H. C. Taylor. March 13th, 1937. (492041.)

7471. "Timing mechanism for operating valves or electric switches." J. Philip. March 15th, 1937. (Cognate applications 8937/37 and 13989/37.) (492269.)

7495. "Means for the automatic control of variable physical conditions." Electroflo Meters Co., Ltd. (Republic Flow Meters, Inc.) March 15th, 1937. (492270.)

7627. "Electric hot-plate." Akt.-Ges. Brown, Boveri Cie. March 27th, 1936. (492185.)

7656. "Prepayment electricity meters." P. C. Peach. March 16th, 1937. (492272.)

7678. "Transformation of electric relaxation oscillations." Radioakt.-Ges. D. S. Loewe. March 28th, 1936. (492275.)

7679. "Television receiver." Radioakt.-Ges. D. S. Loewe. March 21st, 1936. (492276.)

7680. "Rectifier for television signals." Radioakt.-Ges. D. S. Loewe. March 19th, 1936. (492337.)

7682. "Electrical oscillation generators." Marconi's Wireless Telegraph Co., Ltd., and D. J. Fewings. March 16th, 1937. (492278.)

7683. "Electric cables." Marconi's Wireless Telegraph Co., Ltd., and F. E. Robinson. March 16th, 1937. (492279.)

7711. "Electric motor control." British Thomson-Houston Co., Ltd., and B. Adkins. March 16th, 1937. (492281.)

7748. "Electron-discharge devices for use in television and like systems." Baird Television, Ltd., and V. A. Jones. March 16th, 1937. (492284.)

7765. "Electric incandescent lamps." Nox Electric Lamp Co., Ltd. (A. van Dani). March 17th, 1937. (492285.)

7792. "Electric incandescent bodies for producing polarised light." R. Bosch Akt.-Ges. March 19th, 1936. (492286.)

7838. "Electric switches actuated by fluid pressure." Automotive Products Co., Ltd., and G. R. G. Gates. March 17th, 1937. (492293.)

7842. "Vacuum and other sealed-container electric switches." British Thermostat Co., Ltd., and J. E. Sherlock. March 17th, 1937. (492189.)

8007. "Electric interlocking systems for railway signalling apparatus." Westinghouse Brake & Signal Co., Ltd. July 8th, 1936. (492301.)

8008. "Television scanning systems." J. W. Garside. March 21st, 1936. (492302.)

8039. "Selector for automatic telephone systems." G. A. Betulander. March 23rd, 1936. (Cognate applications 8040/37, 8041/37 and 8043/37.) (492308.)

8042. "Selectors for automatic telephone systems." G. A. Betulander. October 20th, 1936. (492309.)

8102. "Means for controlling electric motor or other electric circuits." J. G. Smithson & Co., Ltd., and J. G. Smithson. March, 1937. (492314.)

8175. "Magneto generators for use in telephone or like systems." Automatic Telephone & Electric Co., Ltd. April 13th, 1936. (492321.)

8204. "Goniometer coils for radio direction-finding systems." Standard Telephones & Cables, Ltd., I. R. J. James, and C. F. A. Wagstaffe. March 19th, 1937. (492323.)

8205. "Electric power cables." Standard Telephones & Cables, Ltd., and J. K. Webb. March 19th, 1937. (492324.)

8523. "Ignition-timing devices for internal-combustion engines." D. Eyre, and N. R. Robinson. March 23rd, 1937. (492325.)

8694. "Colour-changing electric-lighting systems." Mickelwright, Ltd., and B. H. Heath. March 24th, 1937. (492327.)

9732. "Secondary emission electron-multipliers." General Electric Co., Ltd., W. H. Aldous, and L. R. G. Treloar. April 6th, 1937. (492055).

9818. "Electromagnetic relays." General Electric Co., and J. E. Collyer. April 6th, 1937. (491980.)

10254. "Adaptors for use in connection with electrical couplings of the plug-and-socket type." J. A. Crabtree & Co., Ltd., H. F. McLoughlin, and B. G. Harrison. April 10th, 1937. (492058.)

10384. "Manufacture of electric-discharge devices employing secondary electron emission." General Electric Co., Ltd., and C. H. Simms. April 12th, 1937. (492059.)

11109. "Electrodes for electrolytic condensers and the like." A. Behr. April 19th, 1937. (492060.)

13436. "Electric heating device for vulcanising indiarubber objects." H. De Csarada, and B. Vrtyel. September 23rd, 1936. (491987.)

13566. "Multi-grid electric-discharge tubes and circuits incorporating such tubes." Naamlooze Vennootschap Philips' Gloeilampenfabrieken. May 15th, 1936. (492064.)

14542. "Method and apparatus for television scanning." S. L. Clothier, and H. C. Hogen-Camp. May 28th, 1936. (492065.)

14986. "Incandescent-lamp holders." A. W. Beuttell. May 29th, 1937. (492068.)

17084. "Electrical systems of remote-control." General Electric Co., Ltd., J. E. Collyer, and N. C. Smart. June 19th, 1937. (491993.)

18444. "Multi-electrode thermionic valves." M-O Valve Co., Ltd., W. H. Aldous, and G. W. Warren. July 2nd, 1937. (Cognate application 13445/38.) (491994.)

20800. "Wireless aerial installations having adjacent transmitting and receiving aerials." Siemens Apparate und Maschinen Ges. July 27th, 1936. (491999.)

22345. "Telegraph transmitters." Autophon Akt.-Ges. August 22nd, 1936. (492000.)

25674. 'Switches for controlling direction-indicators on vehicles." H. F. Day. September 22nd, 1937. (492217.)

29980. "Electric power cables." Standard Telephones & Cables, Ltd., and J. K. Webb. March 19th, 1937. (Divided out of 492324.) (492331.)

30514. "Television receivers." Naamlooze Vennootschap Philips' Gloeilampenfabrieken. November 9th, 1936. (492132.)

30881. "Regulating systems for electric-discharge devices." British Thomson-Houston Co., Ltd. November 13th, 1936. (492225.)

31893. "High-frequency signalling systems." C. Lorenz Akt.-Ges. November 20th, 1936. (492006.)

32938. "Automatic charging means for accumulators." Aktiebolaget Latex, E. M. Thielers, and S. D. Vigren. November 29th, 1937. (492229.)

34214. "Electric condensers." Bryce, Ltd. January 21st, 1937. (492332.)

34696. "Means for supplying current to electric heating elements disposed in electric furnaces and consisting of carbon." I.G. Farbenindustrie Akt.-Ges. December 31st, 1936. (492009.)

36155. "Directional radio receivers." Soc. Francaise Radio-Electrique. December 20th, 1936. (Addition to 470060.) (492011.)

1938

5534. "Electrical fuses." H. E. Taplin. February 22nd, 1938. (492019.)

5598. "Connectors for electric conductors." British Thomson-Houston Co., Ltd. February 24th, 1937. (492244.)

5902. "High-tension fuses." Electric Transmission, Ltd., and K. Dannenberg. February 24th, 1938. (492142.)

6004. "Electric socket casings." United-Carr Fastener Co. of Canada, Ltd. March 3rd, 1937. (492246.)

6112. "Electromagnetic relays." General Electric Co., Ltd., and J. E. Collyer. April 6th, 1937. (Divided out of 491980.) (492021.)

7158. "Devices for receiving modulated high-frequency oscillations." Naamlooze Vennootschap Philips' Gloeilampenfabrieken. March 9th, 1937. (492146.)

8425. "Apparatus for the reproduction of sound films." British Ozaphane, Ltd. March 9th, 1936. (Divided out of 492165.) (492087.)

8936. "Gas-filled or vapour-filled electric discharge vessels." Siemens & Halske Akt.-Ges. March 31st, 1937. (492149.)

9175. "Electric inductors having cores of finely divided magnetic material." Siemens & Halske Akt.-Ges. April 17th, 1937. (492150.)

9460. "Electric-discharge tubes containing secondary-emission electrodes." Naamlooze Vennootschap Philips' Gloeilampenfabrieken. March 30th, 1937. (492250.)

9752. "Method of manufacturing secondary-emission electrodes." Naamlooze Vennootschap Philips' Gloeilampenfabrieken. April 2nd, 1937. (492025.)

15765. "Electric heating device for heating fluids in flow." British Thomson-Houston Co., Ltd. May 28th, 1937. (492155.)

15766. "Electric heating elements." British Thomson-Houston Co., Ltd. May 28th, 1937. (492156.)

Contract Information

Particulars of work for which tenders are invited, contracts placed, and building schemes promising work for electrical contractors and traders

Contracts Open

Where "Contracts Open" are advertised in our "Official Notices" section the date of the issue is given in parentheses. Further details of items marked with an asterisk can be obtained from the Department of Overseas Trade (Inquiry Room), 35, Old Queen Street, London, S.W.1.

Aberdeen.—October 14th. County Council. Electrical work at forty-one houses at Waterton estate. County Clerk, 22, Union Terrace.

October 14th. Electrical work at Fyvie estate (twenty houses). County Clerk, 22, Union Terrace.

Australia.—MELBOURNE.—October 25th. Posts and Telegraphs Department. Outside broadcast amplifiers and equipment. (T. 26878/38.)*

November 2nd. Victorian Railway Commissioners. Electric winder and accessories for the new Kirrak Colliery, Wonthaggi. (T.Y. 27281/38.)*

October 31st. City Council. Five low-voltage air-break circuit-breakers. (T.Y. 27157/1938.)*

BRISBANE.—December 12th. City Electric Light Co., Ltd. One 25,000-kW turbo-alternator and accessories. (T.Y. 26867/38.)*

November 18th. Tramways and Power House Department. Sets of 11-kV, three-phase, 50-cycle switchgear. (T.Y. 27518/1938.)*

VICTORIA.—November 8th. State Electricity Commission. Varnished cambric and p.i. cable. (T. 27159/38.)*

November 22nd. Two 20,000-kVA, three-phase transformers. (T. 27406/38.)*

Banchory (ABERDEENSHIRE).—October 18th. Town Council. Electrical work at Woodside housng estate. Town Clerk.

Birmingham.—November 4th. Electric Supply Department. Construction of the main buildings for Ham Hall "B" power station. (September 30th.)

Blackpool.—October 31st. Electricity Department. 6,600-V, three-phase metal-clad switchgear, and 6,600-V, three-phase transformers. (See this issue.)

Bristol.—October 14th. Electricity Department. One 150-kV DC testing equipment. (September 30th.)

October 17th. Town Council. One 1,500-kVA, three-phase, 6.6-kV transformer. A. J. Newman, chief engineer, Electricity Offices, Colston Avenue (deposit £1 1s.).

Burnley.—October 18th. Electricity Department. 1,570 yd. of 0.2 sq. in. low-voltage cable. (See this issue.)

Bury.—October 31st. Corporation. Electric lighting and power installation at the new Town Hall. Town Clerk, Municipal Offices (deposit £2 2s.).

Cardiff.—November 14th. Electricity Department. 40-W and 60-W gas-filled lamps. (See this issue.)

Cheadle and Gatley.—October 17th. Electricity Department. Extensions to 6.6-kV switchgear for the Larkhill estate substation, Adswood, Cheshire. (September 30th.)

Darlington.—October 22nd. Electricity Department. Wiring installations in Council houses. (October 7th.)

Edinburgh.—October 24th. Scottish Special Areas Housing Association, Ltd. Electric lighting installation at Crofthead estate, West Lothian (ninety-eight houses). Secretary, 73a, Shandwick Place.

Forthcoming Events

Institution of Electrical Engineers.—Thursday, October 20th. Institution, London, W.C.2. 6 p.m. President's inaugural address by Dr. A. P. M. Fleming.

Mersey and North Wales (Liverpool) Centre.—Monday, October 17th. Royal Institution, Colquitt Street. 7 p.m. Chairman's address by Mr. E. L. Morland.

North-Western Centre.—Tuesday, October 18th. Engineers' Club, Manchester. 7.15 p.m. Chairman's address by Mr. W. Fennell.

Northern Ireland Sub-Centre.—Tuesday, October 18th. 9, Wellington Place, Belfast. 6.30 p.m. Chairman's address by Mr. F. Johnston.

Sheffield Sub-Centre.—Wednesday, October 19th. Royal Victoria Hotel. 7.30 p.m. Chairman's address by Mr. H. W. Kefford, to be followed by a smoking concert.

Tees-side Sub-Centre.—Wednesday, October 19th. Cleveland Technical Institute, Middlesbrough. 6.45 p.m. Chairman's address by Mr. H. H. Mullens.

Birmingham Electric Club.—Friday, October 14th. Grand Hotel. 7.30 p.m. Ladies' evening.

Physical Society.—Friday, October 14th. Imperial College of Science and Technology, South Kensington, S.W.7. 5.15 p.m. Opening meeting. Various short papers.

Association of Supervising Electrical Engineers.—Tuesday, October 18th. 2, Savoy Hill, W.C.2. 7.15 p.m. Presidential address by Mr. J. R. Beard.

Institution of Mechanical Engineers.—Thursday, October 20th. Connaught Rooms, Great Queen Street, W.C.2. Annual dinner.

Friday, October 21st. Storey's Gate, St. James's Park, S.W.1. 6 p.m. General meeting. Presidential address by Mr. D. E. Roberts.

Junior Institution of Engineers.—Friday, October 21st. 39, Victoria Street, S.W.1. 7.30 p.m. Ordinary meeting. Paper on "Some Safety Provisions of the Factory Act, 1937."

Egypt.—CAIRO.—October 20th. Ministry of Public Health. Four air-cooled, 25-kVA, three-phase transformers. (T. 27375/1938.)*

Farnworth.—October 25th. Electricity Department. One 1,000-kVA transformer and wiring cables. (October 7th.)

Fife.—October 18th. County Council. Electric lighting at additions to County Offices, Kirkcaldy. County Clerk, Cupar (deposit £1 1s.).

Hastings.—November 2nd. Electricity Department. Galvanised steelwork for overhead lines, creosoted red fir poles, stay blocks and single-phase and three-phase, indoor and outdoor transformers for twelve months. (See this issue.)

Hebburn-on-Tyne.—U.D.C. Electrical installations in 120 houses.

India.—SIMLA.—October 22nd. Indian Stores Department. 1,100-yd. of p.i., l.c., s.w.a., 660-V cable and indoor and outdoor type dividing boxes. (T. 27501/1938.)*

Inverness.—October 25th. Town Council. Electric lighting work at Dalneigh and Glenurquart Road housing estates (100 houses). Town Clerk.

London.—Commissioners of H.M. Works, October 17th. Lighting protection installation at Glascoed R.O.F. (September 30th.)

October 24th. Sub-station switchgear, transformers, &c., at Bridgend R.O.F. (September 30th.)

October 19th. Electrical wiring at Bishopton R.O.F. (September 30th.)

HAMMERSMITH.—October 26th. Electricity Department. Two 500-kVA oil-immersed transformers. (See this issue.)

HORNSEY.—October 29th. Electricity Department. DC and AC electricity meters, maximum demand indicators, DC and AC fixed charge collectors and time switches. (See this issue.)

Manchester.—October 28th. Electricity Committee. AC electric fan motors and three-phase 400/230-V switchgear for twelve months. (See this issue.)

Mansfield.—October 24th. Electricity Department. P.i. lead covered cable. (September 30th.)

Morley.—October 17th. Town Council. Change-over of the electrical installation from DC to the three-phase system at the sewage disposal works. N. Hunter, engineer, Electricity Offices.

New Zealand.—WELLINGTON.—January 17th, 1939. Public Works Department. Outdoor and indoor cable boxes, distribution and connector boxes, &c. (T.Y. 27084/38.)*

January 24th, 1939. Seven 7,400-kVA single-phase transformers complete with accessories. (T.Y. 27512/38.)*

February 14th, 1939. Two 22,200-kVA generators and two 28,000-h.p. turbines. (T.Y. 27513/38.)*

November 30th. Posts and Telegraph Department. Telephone cable. (T.Y. 26940/38.)*

CHRISTCHURCH.—November 10th. Electricity Department. Two voltage regulators. (T. 27502/1938.)*

DUNEDIN.—October 31st. Electric Power and Light Department. Four 400-A circuit-breakers. (T. 26943/38.)*

AUCKLAND.—November 21st. Electric Power Board. 7,000 yd. of p.i. cable, thirty joint boxes, two-end dividing boxes, together with necessary jointing material and compound. (T. 27082/38.)*

Portsmouth.—October 18th. Electricity Undertaking. 33-kV p.i. lead-covered wire-armoured cable. (September 30th.)

South Africa.—PRETORIA.—October 20th. Union Tender and Supplies Board. One 1,000-kVA transformer. (T. 26989/38.)*

JOHANNESBURG.—October 15th. City Council. High- and low-voltage p.i. power cable. (T.Y. 27094/38.)*

October 19th. Circuit-breaker testing equipments. (T.Y. 27090/38.)*

PORT ELIZABETH.—November 10th. 22,000-V, 0.15 sq. in., three-core cable and accessories. (T.Y. 27462/38.)*

Stoke-on-Trent.—November 2nd. North West Midlands J.E.A. Painting of chimney stacks, &c. Overhead transmission lines. (September 30th.)

Uruguay.—MONTEVIDEO.—October 18th. State Electricity Supply and Telephones Administration. Galvanised steel cable. (T.Y. 26947/38.)*.

Walsall.—October 24th. Electric Supply Department. Materials and apparatus for twelve months. (October 7th.)

Orders Placed

Banff.—Works Committee. Accepted. Installation of electric lighting at Fordyce schools (£160).—W. G. Davidson.

Barrow-in-Furness.—Electricity Committee. Accepted. Six surge absorbers.—Ferranti. Conduits (£1,413).—Albion Clay Co. Extra-high-voltage switchgear (£1,718).—B.T.H. Co. Low-voltage switchgear (£129).—W. Lucy & Co.

Birkenhead.—Electricity Committee. Accepted. Wiring of forty-nine houses (£222).—Park Electrical Co.

Bradford.—Sewage Committee. Recommended. Electro-static precipitator at Esholt sewage works (£3,314).—W. T. Holmes & Co.

Electricity Committee. Accepted. Distribution lines at Tyersal and Holme Village.—B.I. Cables.

Chesterfield.—Electricity Committee. Accepted. Cable (£270).—Ismay Cables. Switchgear (£106).—Switchgear & Cowans. Oil switch unit (£45).—Long & Crawford.

Colchester.—Education Committee. Accepted. Electrical installation at Wilson Marriage School (£356).—E. H. Ruddock.

Hull.—Education Committee. Accepted. Electrical installation at Wheeler Street School (£620).—A. Lee.

Dumfries.—Corporation. Accepted. Low-voltage cables for twelve months.—Scottish Cables.

Durham.—East Crook and Willington U.D.C. Accepted. One 300-kVA transformer with 20,000-V cables and switchgear (£1,881).—English Electric Co.

Eccles.—Housing Committee. Accepted. Wiring 158 council houses (£1,059).—G. Tooth & Son.

Plymouth.—Electricity Committee. Accepted. Distribution boards.—W. Lucy & Co. Disconnecting boxes.—G. P. Cosway. Conversion of lifts (£277).—Express Lift Co.

Portsmouth.—Electricity Committee. Accepted. Rectifier equipment (£1,308).—English Electric Co. Cable (£347 per 1,000 yd.).—Johnson & Phillips.

Seaton Valley.—U.D.C. Accepted. Electrical installations in thirty-two houses at Holywell Village.—J. B. Wilson.

Sunderland.—Town Council. Accepted. X-ray equipment for the Cherry Knowle Mental Hospital (£1,477).—Schall & Son.

Torquay.—Housing Committee. Accepted. Wiring 188 houses on the Watcombe estate (£764).—F. B. Oldham.

Wakefield.—Baths Committee. Accepted. Electric boiler, griller and slicer.—James Stott & Co.

Work in Prospect

Publication in this list is no guarantee that electrical work is definitely included. Alleged inaccuracies should be reported to the Editors.

Barking.—Factory, Alfred's Way; F. Geymer & Son. Factory, River Road; Organ & Co., Ltd. Factory, Wakering Road; H. Brown & Son.

Barnet.—Factory, Barnet By-pass, for the Royal National Lifeboat Institution, 42, Grosvenor Gardens, London, S.W.1; H. Kenchington, architect, 7, Staple Inn, Holborn, London, W.C.1. Enlargement of Wellhouse Hospital (£61,000); Saxon Snell & Phillips, architects, 9, Bentinck Street, London, W.1.

Barrow-in-Furness.—Houses (14), Southport Drive; Links Estate, Ltd.

Bath.—Houses (58), Twerton; city engineer.

Batley (YORKSHIRE).—Shops and offices, Commercial Street, for Bell Estates, Ltd.

Billericay.—Houses (68), shops and factory, Arterial Road; L. R. Scott.

Birkenhead.—Extensions to bus garage (£71,000); borough engineer.

Birmingham.—Factory and offices, High Street, Deritend, for Haddon & Co.; T. Elvins & Sons, builders, Soho Hill.

Bolton.—Houses (10), Cleveleys Avenue; Joseph Staton, Ltd. Flats (28), Willows Lane; borough engineer. School, Lever Edge Lane, for the E.C.

Bradford.—Houses (78), Birkslend estate, and schools, Fairweather Green and Parkside Road; city architect.

Caerphilly.—Houses (50), Trecenydd estate; U.D.C. surveyor.

Chesterfield.—Houses (40), Orchards Way; I. D. Wilcockson. Extensions to works, Sheffield Road; Lamp Caps, Ltd.

Coalburn (LANARKSHIRE).—Houses (102), for Scottish Special Areas Housing Association, Ltd.; T. D. W. Gratton, architect, 93, Douglas Street, Glasgow, C.2.

Colchester.—Houses (10), Cavendish Avenue; Whitehall Development Co., Ltd. Houses (12), Cowdray Avenue; A. E. Sparrow. Extensions to bus garage (£6,461); borough engineer.

Croydon.—Extensions to factory, for Morrison, Carpenter & Co., Bedford Park.

Dartford.—Works for J. C. Beadle, Ltd., Spital Street; P. D. Stonham & Son, architects, Hadley House, Upperton Road, Eastbourne.

Dumbarton.—Additions to tube and valve works, for Babcock and Wilcox, Ltd.; L. Short, manager.

Dunmow.—Houses (56); R.D.C. surveyor.

Durham.—Hospital (£100,000); city engineer.

Eccles.—Houses (58), vicinity of Barton Lane; G. Halliwell.

Edinburgh.—Extensions to the Royal (Dick) Veterinary College (£36,000).

Gateshead.—Houses, Kells Lane, for A. Parsley; F. Davies, architect, 560, Durham Road, Low Fell.

Glasgow.—Extensions to factory, for MacMillan & Monro, 90, Logan Street.

Hitchin.—Enlargement of Chalkdell Institution (£28,000); W. H. Hobday, architect.

Hoddesdon.—Factory, for Shockcrete Products (London), Ltd., Stone House, Bishopsgate, E.C.3.

Hull.—Ice rink and sports stadium; J. A. Adamson, architect, 56, Victoria Street, London, S.W.1. Tile works, Witham; M. B. Harding, Ltd. Houses (200), Bilton Grange estate; city architect.

Ilford.—Houses (46), Havering Gardens; J. Giles, Oaks Lane, Aldborough Hatch. Extensions to isolation hospital (£10,938); E. A. Russell, Ltd.

Ilkeston.—Extensions to textile factory, Corporation Road; Charnos Hosiery, Ltd.

Ipswich.—Extensions to works, for Phillips & Piper, Old Foundry Road; Cubitt & Gotts, Ltd., contractors, Westerfield.

Jarrow-on-Tyne.—Cinema, for Smelts Cinema, Ltd., Newcastle-on-Tyne.

Leeds.—Large store premises, Briggate; Marks & Spencer, Ltd.

Liverpool.—Premises, Great Crosshall Street, Fontenoy Street and Primrose Hill, for W. T. Avery, Soho Foundry, Birmingham. Premises, Kingsway, for Woodson's Stores, Ltd.; Sergent & Co., builders, Carisbrooke Place, Walton.

London.—(HOLLOWAY).—Cinema, shops, &c., Holloway Road, for the Associated British Cinemas, Ltd.; N. R. Glen, architect, 30, Golden Square, London, W.1.

Loughborough.—Extensions to Shelthorpe schools (£12,000), for the E.C.

Manchester.—Additions to showrooms and offices, High Street, for Lowcock & Co., Ltd.; A. Wych, architect, Market Street, Denton.

Newbury.—Extensions to premises, for Wheelers (Newbury), Ltd., Broadway.

Newcastle (STAFFORDSHIRE).—Cinema, for the Associated Cinema Properties, Ltd., 30, Golden Square, London, W.1.; W. R. Glen, resident architect.

Newcastle-on-Tyne. — Houses (16), Westwood Gardens; Cunningham and Forster, builders, Kenton Lane. Offices, Corporation Street, for the United Yeast Co.; Stanley Miller, Ltd., builders, North Street. Showrooms and garage, Warwick Road; Marshall, Tweedy and Bourn, architects, Grainger House, Newcastle-on-Tyne. Reconstruction of leather works, Barrack Road, for J. Taylor Dunford and Co.; P. L. Browne, Son and Harding, architects, Pearl Buildings, Northumberland Street.

Norwich.—Large block of offices, Upper King Street (£30,000); Buckingham & Berry, architects, 432, Prince of Wales Road.

Oldbury.—Houses (48), Tinkers Farm estate; S. H. Rowe.

Oldham.—Aircraft factory, Greengate, Chadderton, for A. V. Roe & Co., Ltd., Newton Heath, Manchester, 10.

Plymouth.—Houses (24), Church Way; Davis Estates, Ltd. Bathing station, Hoe (£24,397); J. W. Spencer. Health centre (£3,300); city architect. School, Montpelier (£49,947); Dudley Coles.

Pontefract.—Extensions to factory, Monkhill; W. R. Wilkinson & Co., Ltd.

Portsmouth.—Baths, Victoria Park; city engineer. Institution (£105,160); Kirk & Kirk, Ltd.

Ramsgate.—Town hall, corner of Leopold Street, and covered market, rear of Charlotte Court; borough surveyor.

Rotherham.—School (£23,962); Beeden, Ltd.

Rowley Regis.—Houses (20), Uplands Avenue, Blackheath; J. T. Bloomer. Houses (264) and six shops, Tividale; A. & J. Micklow, 21, High Street, Blackheath, Birmingham.

Rugby.—Houses (17), Little Farm estate; Dester Bros., Southfields estate. Houses (20), Rugby estate, for Bolt Building Co.

Sheffield.—Houses (29), Gillott Street and Mona Road and Den Bank Crescent; A. Spooner, 520, Manchester Road, Sheffield, 10. Houses, Welwyn Road and Jaunty Lane; W. A. Wright, 99, Sandford Grove Road. Baths, Main Road, Darnall; city architect.

Shropshire.—School, Wellington (£26,800), for the County E.C.

Solihull.—Cinema, Warwick Road, for Avion Cinema Co.; R. Satchwell, architect, 6, New Street, Birmingham.

South Shields.—Hotel, Marsden (£20,000); T. K. Page, Son & Bradbury, architects, 75, King Street, South Shields.

Southall.—Extensions to factory, Brent Road; Kearley & Tonge, Ltd.

Stafford.—Houses (48), Holmcroft estate, for the West Heath Estates, Ltd.

Staines.—Houses (168), Echelforde Garden Village, Ashford; A. P. Watts.

Stretford.—Biscuit factory, Warwick Road; International Biscuit Co.

Sunderland.—Houses (22), Ludlow Road, for R. G. Finlay, Ltd.; G. E. Matkin, architect, Barclays Bank Chambers, Sunderland. Houses (12), Mayswood Road; J. Prentice, contractor, St. Nicholas Avenue. Mineral water factory, Pallion estate; W. and T. R. Milburn, architects, 17, Fawcett Street.

Tadcaster.—Houses, Swillington and Sherburn; R.D.C. surveyor.

Tamworth.—Fire station (£10,620); borough surveyor.

Wakefield.—Houses, Darnley and Portobello estates; G. Crook & Sons, Ltd.

Wallsend-on-Tyne.—Houses (104), King's Road East; W. Leech, contractor, 2, Clayton Street, Newcastle-on-Tyne. Shops for the North Heaton Development Co.; Marshall, Tweedy and Bourn, architects, Grainger House, Newcastle.

Walsall.—Cinema and shops, Broadway and Hawes Road; Mrs. Maud M. Summers.

Waltham Cross.—Offices, for the Cheshunt Building Society, Crosbrook Street.

Welwyn.—Factory, Hyde Way, for Barclay Corsets, Ltd., 133, Regent Street, W.1; L. de Soissons, architect, Blue Bell Yard, St. James, London, S.W.1.

Whitby.—Houses (16), Castle Park; R. A. Wilson and Son, builders, Whitby.

Wisbech.—Isolation hospital; F. Burdett Ward & Woolnough, architects, South Brink, Wisbech.

Worcester.—Factory, Northwick Road, for Russell & Worrell, Ltd., College Street.

Workington.—Factory; Woodpulp, Ltd.

York.—Block of offices and shops fronting on Davygate for the Malton Investment Trust.

Yorkshire.—School, Cross Flatts, Bingley, for the West Riding E.C.